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SPINNING MOLLUSCS.

By H. Wallis Kew.

(Plate III.)

The production of a mucus-thread, as a means of progression through the air, has long been known in the Land-Slugs, and has been observed in seven genera, representing *Limacidæ*, *Arionidæ*, and *Philomycidæ*.

The Spinning-Slug (*Limax filans*) of authors is a myth, the habit being general, extending possibly to all Slugs of the families named. The animals are occasionally seen descending from trees, fences, rafters in greenhouses, &c., and they are easily induced to descend from small exposed objects on which they may be placed. They crawl from the object, and, when the tail parts company with it, the animal is sustained by a thread, which is left by the body at the tail, and is gradually lengthened. Sometimes the animal thus reaches a new support without a fall, but the faculty is imperfect, the animal often falling either without a thread or after making a short one. Large Slugs, when full-grown, are incapable of this kind of locomotion; but small ones, and the young of large kinds, are occasionally capable of making successful descents of surprising length. Threads measuring 3–7 ft. have several times been observed, and others 8–9 ft. long have been reported.

On the foot of the descending animal wave-like appearances

are observable; these are the result of muscular action identical with that giving rise to the creature's ordinary locomotion; and we have here a clue to the nature of the progression through the air and of the thread. Whenever a Slug is in motion it discharges mucus, chiefly from the supra-pedal gland below the mouth; in ordinary locomotion it crawls over a film of this mucus which remains behind as a trail, and when in the air it crawls over a similar film, which collapses into a thread as the animal leaves it; this thread represents the trail in every respect, is derived in the same manner, and is in fact a continuation of it. The thread is lengthened by the continued crawling action, combined with a constant discharge of mucus, and perhaps also by the weight of the animal, which appears to elongate the collapsing film. There is thus no special spinning-organ. The thread, however, is of extreme fineness, and is silky when dry; it generally springs up and floats (remaining attached at the point of origin) when the animal alights; but it sometimes becomes attached to the new support, and is left, marking the animal's aerial course. If the animal does not find a new support, or fall, it sometimes turns upon its thread, ascends it, and regains the former support; it creeps up the thread as on a solid body, the slack (with other mucus emitted during the ascent) accumulating at the tail. It is chiefly when the creatures find themselves exposed to sunshine, dry atmosphere, or other dangers that they crawl from their supports. One doubts, however, whether they derive much advantage from the use of the thread; there is no reason to suppose that they would often be injured if they dropped (as they often do by reason of the imperfection of their spinning). Falls of a few feet do not appear to be harmful; and the writer regards the Slug's spinning as little more than an accidental circumstance resulting from the possession, for ordinary locomotion, of a continuous supply of tenacious mucus.

This faculty of making and using a thread, far from being confined to Land-Slugs, is found to extend not only to shell-bearing Pulmonata, but also to the remaining orders of Mollusca-Gastropoda—Opisthobranchiata, Pectinibranchiata, and Aspidobranchiata (with the possible exception of the last); and the writer's principal object in the present paper is to bring together certain scattered information concerning the so-called spinning

habits of these latter creatures—terrestrial, fresh-water, and marine univalves, and Sea-Slugs.*

PULMONATA.

In Pulmonata, other than Land-Slugs, spinning chiefly occurs among the air-breathing fresh-water Snails, in which it is probably general. Among the Land-Snails of the order it appears to be very rare; the *Helicidæ* (typical Snails) are entirely unrepresented, as also, with the exception of a single genus, are all the other groups with Helicoid shells. For *Pupidæ* we have two notes, but these, as it appears to the writer, are in need of confirmation. With regard to the more or less Helicoid, semi-Slug-like *Vitrina pellucida*, one finds that Mr. Collinge several times tried, without success, to induce the creature to suspend itself;† and a few trials by the writer with various land-shells (which were placed on twigs of needle-furze, &c.) were also unsuccessful, the animals gliding off and falling without a thread, or retiring into their shells and remaining on the twigs. In *Testacellidæ*, I tried *Testacella scutulum*; in *Vitrinidæ*, *Vitrina pellucida*; in *Helicidæ*, young *Helix aspersa* and *nemoralis* (or *hortensis*); in *Pupidæ*, *Clausilia laminata* and *C. rolphii*; and in *Stenogyridæ*, *Cochlicopa lubrica*.

Zonitidæ.

According to Andrew Garrett, the mucus of *Trochonanina conula*,‡ and of other species of *Trochonanina*, is unusually tenacious, "and the animals possess the habit of 'thread-spinning' to perfection"; so much so, it is added, that it requires no small amount of patience, while gathering specimens, to detach them from the fingers, and secure them in the box or vial.§

* On the subject of the mucus-threads of Land-Slugs, I hope to give, in another place, details of observations and references; in addition to these molluscs, and to those now considered, the Mollusca-Pelecypoda (bivalves) are thread-makers and byssus-spinners, but I am unable at present to write of the habits of this class of Mollusca. For help in preparing the present paper, and in other tasks, I am much indebted to the courteous and continued co-operation of my friend Mr. G. K. Gude.

† Collinge, Zool. (3), xiv. (1890), p. 468.

‡ *Microcystis conula.*

§ Garrett, 'Journal of the Academy of Natural Sciences of Philadelphia' (2), viii. (1881), pp. 383–4; ix. (1884), p. 21.

These little Snails, as far as the writer has ascertained, are the only Helicoid-shelled molluscs known to make threads; the *Trochonanina conula* was collected by Garrett from foliage of bushes in the Cook's or Harvey Islands, and in the Society Islands.

PUPIDÆ.

There is a statement in Mr. Tye's "Molluscan Threads" (1878) that Mr. Dixon, of Leeds, "has seen several individuals of *Clausilia rugosa* var. *dubia* suspended."* A number of *Clausilia rugosa* kept by the present writer for a considerable time in glass vessels, with twigs, &c., were not seen, however, to use a thread; and, as indicated above, two other species of *Clausilia* have been experimented with on twigs of needle-furze with similar negative results. *Clausilia rugosa*, it is true, was sometimes seen hanging during rest by a point of dried mucus, attaching the lip of the shell to the object of support, and allowing the creature to swing freely; but this, apparently, was merely the result of the breaking away or failure of the greater part of the film by which resting *Clausiliæ* ordinarily fix the mouth of the shell; a method of attachment familiar to us in the common Snails (*Helix*, &c.). In *Helix* (and probably in *Clausilia* also) the mucus of this attachment comes, not from the foot, but from the mantle. On inquiring of Mr. Dixon, in 1893, the writer found that the observation on *Clausilia* had passed from his memory; he stated, however, that he had seen *Balea perversa*, in the Isle of Man, suspended by a string of mucus about an inch long from the under side of stone ledges; he supposed that the animals, in crawling over the ledges, had overbalanced, and that their mucus, more glutinous than usual owing to the dry weather prevailing at the time, had held them suspended, and had been gradually drawn out by the weight of the mollusc.

LIMNÆIDÆ.

The air-breathing fresh-water Snails of this and the next family are notorious spinners, the habit being associated with the visits to the surface of the water which most of these creatures are compelled to make from time to time for the purposes of respiration. Most of them have light shells, and when

* Tye, 'Quarterly Journal of Conchology,' i. (1878), p. 412.

the animal is extended, and the lung-sac filled with air, they differ from truly aquatic and truly terrestrial molluscs in being slightly lighter than the medium in which they live; when detached they generally rise to the surface, and from this position they appear to be unable to drop, except when they withdraw into their shells and expel air from the lung-sac. It thus happens that they usually spin upward instead of downward threads—a circumstance in which they differ, as far as the writer has ascertained, from all other molluscs. The process is probably identical with that seen in *Limax*, but the thread, instead of preventing the animal's fall, prevents its sudden rise to the surface. The animal, gradually raising the anterior part of its foot from the bottom on which it is travelling, crawls upwards through the water upon its slime, which, left behind in the form of a thread, retains the animal as it slowly ascends to the surface, to which, or to the slime-film now deposited there, the thread is fixed; subsequently, crawling down the thread thus fixed, the creature uses it as a means of descent to its former position. Mr. Warington long ago published notes on this subject, but we are chiefly indebted for our information to Mr. Tye.* The latter naturalist kept most of the Limnæids of this country in captivity for the purpose of observing their spinning. Some spun both when young and adult, others when young only; and, while some used their threads frequently, others did so rarely or not at all. The observer concludes, however, that all are more or less expert in this respect, and that "in the pellucid stillness of their own domain, when the eye of man is not present to pry into their daily avocations, this beautiful and delicate method of travelling is often used by them." It is maintained by this author, and by Mr. Taylor,† that the creatures can spin downward as well as upward threads; and from the observations of these naturalists it certainly appears that when the air in the lung-sac is sufficiently exhausted, the animal is heavy enough, while yet

* Warington, 'Annals and Magazine of Natural History' (2), x. (1852), pp. 273–6; (2), xiv. (1854), p. 366; Zool. x. (1852), pp. 3634–5; xiii. (1855), p. 4533; Tye, Hardwicke's 'Science-Gossip,' 1874, pp. 49–52; 'Quarterly Journal of Conchology,' i. (1878), pp. 401–15.

† Taylor, 'Monograph of the Land and Freshwater Mollusca of the British Isles,' i. (1899), pp. 318–9.

extended from its shell, to descend through the water, making a thread as it goes, and to remain suspended in the water upon a thread thus made. This, however, it is believed, but rarely happens. Several of the observations quoted below, it is true, imply descent and suspension; but, as the thread is generally invisible, it is possible that the animals, in some cases, may have been descending, or resting, upon threads already spun and fixed during ascent. The animal's ability to ascend or descend is attributed by Mr. Tye wholly to the condition of the lung-sac; the creatures are lighter than water, he says, when the sac is inflated, and heavier than water when the air of the sac is exhausted or expelled. It must be remarked, however, that it is when the air is exhausted that the creatures ordinarily require to ascend, and when the sac is fully inflated that they have to descend. It seems to the present writer that the changes in the creature's specific gravity are largely contributed to by the contraction or extension of the animal itself into or from its shell; and it is probable that the creature, when sufficiently heavy to sink, is usually too much contracted and withdrawn to form a thread. It is interesting to note that Mr. Tye recognizes the fact that here, as in *Limax*, the thread represents the mucus-trail of ordinary progression, such a trail, though usually invisible in the case of a Limnæid, being always present in the track of the moving animal. On plants in vessels in which molluscs have been kept for a few days, Mr. Tye adds, a network of mucus stretches from leaf to leaf, and is readily apparent when fresh water is put in, the bubbles given off by the plants then adhering to the mucus-lines.*

* The locomotory mucus, besides serving for ordinary crawling on solid bodies (when it is left behind as an attached trail), and for crawling through the water (when it is left in the form of a thread), serves also for a similar crawling progression at the surface of water, the animal, foot uppermost, now leaving the mucus in its path in the form of a floating trail. Limnæids and Physids are often seen thus crawling at the surface of the water of aquaria and of ponds; and the habit, which is common to many gastropods of all orders, was long a puzzle to naturalists. Alder and Hancock (1), however, who studied it in Nudibranchia (Sea-Slugs), saw the movements of the foot-sole to be those of ordinary crawling, and recognized the fact that the creature's progress was caused by these movements against the mucus which it emits and leaves in its track. The animal thus crawls along the floating

Limnæa.—"In watching the movements of *Limnææ* in the aquarium," says Mr. Warington, "I was for some time under the impression that they had a power of swimming or sustaining themselves in the water, as they would rise from the bottom of the pond, a portion of the rock-work, or a leaf of the plants, and float for a considerable period, nearly out of their shells," without any apparent attachment. On carefully watching this phenomenon, he found that the creatures "were attached by a thread or web, which was so transparent as to be altogether invisible, and which they could elongate in a similar way to the Spider; they also possessed the power of returning upon this thread by gathering it up as it were, and thus drawing themselves back to the point which they had quitted." The observer mentions a case in which a *Limnæa stagnalis*, having reached the extremity of a leaf of *Vallisneria*,

mucus, the authors maintain, just as it does on the attached mucus which it sheds on its path on a solid body. Willem (2), it may be added, evidently unacquainted with the work of Alder and Hancock, has confirmed their conclusions from observations on *Limnæa* and *Planorbis*:—"Les Gastéropodes d'eau douce," he says, "pour glisser renversés à la surface de l'eau, commencent par prendre appui sur la mince pellicule superficielle qui recouvre toujours l'eau des mares et des étangs; puis ils *rampent à la face inférieure d'un mince tapis de mucus que leur pied sécrète au fur et à mesure de la progression.* Cette locomotion," the author adds, "ne diffère de la locomotion sur les corps solides qu'en ce sens que, lors de la locomotion aquatique, le Mollusque est réduit à tirer parti de la rigidité de la seule traînée de mucine, tandis que, dans l'autre cas, la traînée est elle-même collée à une surface solide." By blowing lycopodium powder on the surface of the water, Willem clearly demonstrated the presence of the floating trail; the grains, gathering into groups on the rest of the surface, adhered evenly to the band of mucus, and showed it distinctly. Under natural conditions this floating trail is usually invisible, but not invariably. We find, for instance, that Mr. Crowther (3), passing along a disused canal connecting bends of the Calder, distinctly saw the tracks of *Limnæa stagnalis* at the surface of the clear water, in the sunshine, with a darkened background of black mud; they appeared as whitish iridescent paths of mucus, 6–8 ft. long, and half an inch wide, mostly straight, and often crossing one another nearly at right angles. (1) Alder and Hancock, 'Monograph of the British Nudibranchiate Mollusca,' 1845–55, pp. 20–1; (2) Willem, "Note sur le procédé employé par les Gastéropodes d'eau douce pour glisser à la surface du liquide," 'Bulletins de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique' (3), xv. (1888), pp. 421–30; (3) Crowther, "Mucous Tracks of *Limnæa stagnalis*," 'Journal of Conchology,' viii. (1896), p. 230; and see also Taylor, *tom. cit.* p. 316, fig. 607.

launched itself off from it; and, after moving about with a sort of swimming or rolling motion in a horizontal direction for some time, lowered itself gradually. During the descent, the flexible leaf was bent with an undulating motion, corresponding with every movement of the Snail, and making it clear that the animal had an attachment to the extremity of the leaf. Proof of the existence of a thread was obtained also by means of an experiment which the observer often repeated with *Limnæa stagnalis*, *L. auricularia*, and *Amphipeplea glutinosa*.* When the Snails were some inches from the supposed point of attachment, a rod was introduced, and slowly drawn on one side in a horizontal direction; and, by this means, the Snails were made to undulate to and fro, obeying exactly the movement of the rod. This had to be done gently, for when too much force was used the thread broke, and the animal rose rapidly to the surface. According to Mr. Tye's observations, *Limnæa glabra* spins its upward thread well and easily; *L. stagnalis*, when young, does the same, but the habit decreases as the animal grows older; the same is the case with *L. palustris*, which, however, was not seen to use a thread as often as *L. stagnalis*. *L. auricularia*, *L. truncatula*, and *L. peregra*, though kept under observation by Mr. Tye, were not seen by him to spin. Mr. R. M. Lloyd, however, had observed the habit in the last-named species. The present writer has noted *L. peregra* and *L. palustris*, presumably retained by threads, slowly rise through the water in aquaria; the *L. peregra*, which was extended as if crawling on a solid body, did not always keep its foot in the same plane, from which fact the writer concludes that it was not creeping up a thread already fixed. The water through which it rose was about eight inches deep; and, on arriving at its destination, the animal applied its foot to the surface-film of the water, under which it crept in the usual inverted position. In *L. auricularia*, the use of a thread was observed, as we have just seen, by Mr. Warington. Mr. Taylor, also, has seen this species spin, and has recently published a figure of an individual using a thread. This figure (Fig. 1) shows the animal, moderately extended from its shell, suspended from the surface of the water upon a downward-spun thread. The drawing was at first supposed by the writer to be

* *Limnæa glutinosa.*

inaccurate; but Mr. Taylor, replying to an enquiry, states that it represents an observation made in his aquarium in 1889; and assures me that he has several times witnessed the formation, by Limnæids, of short downward threads.

Amphipeplea.—The use of a thread by *Amphipeplea glutinosa** has been observed, as already noted, by Mr. Warington. One individual was seen to gradually rise, from a piece of rock in the aquarium, to a distance of three to four inches; it then stayed its progress, and soon afterwards rose suddenly and rapidly to the surface, the retaining thread having evidently given way. Professor Tate has remarked that the water in which this animal is kept, if shallow and insufficient, "is soon rendered glutinous with their mucus-threads";† and Mr. F. W. Fierke, who kept specimens in a jar, mentions threads of mucus "connecting weed to weed, and sometimes even decorating the shells of other molluscs with which *L. glutinosa* had evidently come in contact"; he mentions, also, having observed the animal gently rise through the water.‡

Planorbis.—In the flattened Limnæids of this genus (coil-shells), we are again indebted, for the first observation, to Mr. Warington, who appears to have seen the habit in several species. Mr. Tye saw it—less frequently than in *Limnæa*—in *Planorbis spirorbis*, *P. carinatus*, *P. complanatus*, and *P. contortus*, but not in six other species kept under observation. In *P. complanatus* the habit has been noted, also, by Mr. Musson.§

Segmentina.—*Segmentina lineata*‖ was kept by Mr. Tye, but was not seen to spin. We have a statement by Professor Cockerell, however, that one of his brothers, who had been keeping specimens in a bell-jar, had seen one "spinning a downward thread" from the surface of the water to the bottom of the bell-jar.¶

Ancylus: aberrant Limnæids (fresh-water Limpets).—Mr. Clark, long ago, saw that *Ancylus fluviatilis* living on pebbles in

* *Limnæa glutinosa.*

† Tate, 'Land and Fresh-water Mullusks of Great Britain,' 1866, p. 198.

‡ Fierke, 'Journal of Conchology,' vi. (1890), p. 253.

§ Musson, 'Land and Fresh-water Shells of Nottinghamshire,' 1886, MS.

‖ *Planorbis lineatus.*

¶ Cockerell, "*Segmentina lineata*, Walker, a Thread-spinner," 'Zoologist' (3), ix. (1885), p. 267.

brooks with a rapid current, must find it difficult to visit the surface to breathe, unless, as he suggests, it has the power "of veering out a filamentary cable," by which it can return to its original site.* It is probable, however, that the species of *Ancylus* are not bound, like the majority of Limnæids, to visit the surface; and, in all probability, they do not spin upward threads. For *Ancylus lacustris* we have a note by Mr. Taylor:—

"My valued correspondent, Mr. T. D. A. Cockerell, has communicated to me the interesting circumstance that this species has the power possessed by many other *Lymnæidæ* of spinning a mucus-thread. He says: 'I have just been watching a young specimen of *Ancylus lacustris* spinning a downward thread.' According to the rough but characteristic sketch of the circumstance made by Mr. Cockerell, the thread was about half an inch long, attached to the extremity of a leaf of the *Anacharis*, the body of the animal being bent during the operation, the head and tail nearly close together."†

The sketch referred to was not published by Mr. Taylor; but the writer is permitted to give a copy of it (Fig. 2). The animal appears to be the only mollusc with a Limpet-like shell known to produce a thread.

Physidæ.

The air-breathing freshwater Snails of this family resemble *Limnæidæ* in habits; but they possess greater activity, and make a more general use of threads. Montagu (1803) states that *Physa fontinalis*‡ "will sometimes let itself down gradually by a thread affixed to the surface of the water, in the manner of the *Limax filans* from the branch of a tree."§ Here, however, as in some other cases, the animals observed were possibly descending threads already fixed; for Physids, like Limnæids, are ordinarily slightly lighter than water; and they spin their threads generally, if not invariably, during ascent. The habit was noticed also in *Physa fontinalis* by Mr. Warington, who states that on one occasion introducing a rod between the creature and its point of attachment, he moved it out of its straight course a considerable

* Clark, 'Annals and Magazine of Natural History' (2), xv. (1855), p. 285.

† Taylor, "*Ancylus lacustris*, a thread-spinner," 'Journal of Conchology,' iv. (1883), p. 127.

‡ *Bulla fontinalis*. § Montagu, 'Testacea Britannica,' 1803, p. 227.

distance; and, by then slowly drawing the rod upwards, he succeeded in raising the Snail out of the water, a space of about seven inches, suspended by its thread, which, though difficult to see in the water, now became distinctly visible. Mr. Tye chiefly observed *Physa hypnorum;* he states, however, that *P. fontinalis* uses its thread in a similar way, though less frequently. According to this observer, the young, as soon as they issue from the egg, are capable of spinning a thread and rising to the surface of the water:—

"If my readers wish to see for themselves this habit of travelling, as used by the mollusca, let them take a few adult *Physa hypnorum* . . . place them in a glass vessel with some small pebbles at the bottom and a little weed . . . and keep them until they deposit spawn. As soon as the young are free from the spawn mass they will commence spinning, and practise it so often that the process may be seen at any time."

All the threads observed were spun upwards during ascent to the surface; the longest were the work of *P. hypnorum*, and were spun in a vessel in which the water was fourteen inches deep; they extended from the bottom to the surface. When a *P. hypnorum*, spinning its upward thread, was much disturbed, it was seen to abandon the idea of reaching the surface, and to turn and descend the unfinished thread, altering its position, Mr. Tye says, with much dexterity and ease by bringing its extremities together, and changing the point of attachment of the thread from the tail to the head. This is certainly a curious performance; but, allowing for the reversed condition of specific gravity, it will be noted that it exactly corresponds with the turning and ascent of a thread by *Limax;* the buoyancy of *Physa*, of course, keeps the thread taut, just as does the weight of *Limax*. When the animal completes its thread, it attaches it at the surface of the water, a minute concavity at the upper end acting, according to Mr. Tye's description, like a small boat, of air, and sustaining the thread; but it is more correct to say, perhaps, that the thread is continued at the surface in the form of a floating slime-trail, and that, thus anchored, it slightly cups the water's surface-film. When the *Physa* returns from the surface by descending its thread, Mr. Tye further observes: the thread—not invariably gathered up and carried back—sometimes remains attached to the surface; and in that case, it may be used, both

for ascent and descent, as a more or less permanent ladder; it is strengthened by an additional trail of mucus each time a mollusc passes over it, and thus it becomes somewhat strong and lasts for a considerable time. Mr. Tye had young *P. hypnorum* crawling up and down fixed threads of this kind for eighteen to twenty days together; and on one occasion he noted three individuals, and a *Limnæa glabra*, upon a *Physa's* thread at the same time:—

"Often, when two *Physæ* meet upon the same thread, they fight as only molluscs of this genus can, and the manœuvres they go through upon their fairy ladders outdo the cleverest human gymnast that ever performed. I once saw one ascending, and when it was half-way up the thread it was overtaken by another; then came the 'tug of war'; each tried to shake the other off by repeated blows and jerks of its shell, at the same time creeping over each other's shell and body in the most excited manner. Neither being able to gain the mastery, one began to descend, followed by the other, which overtook it, reaching the bottom first. Yet they are not always bent upon war, but pass and repass each other in an amicable spirit. One of the most beautiful sights in the molluscan economy is to see these little 'golden pippins' gliding through the water by no visible means; and when they fight, to see them twist and twirl, performing such quick and curious evolutions, while seemingly floating in mid-water, is astonishing, even to the patient student of Nature's wonders."

This use of threads as more or less permanent ladders is unique, as far as the writer knows, among all the mollusca. Mr. W. Jeffery, who kept *Physa hypnorum* in an aquarium, has referred to the creature's habit of spinning a thread while rising perpendicularly to the surface; he notes that after taking in a supply of air it may turn leisurely about and crawl down the same thread; and mentions that once, while the animal was thus returning, the thread parted from its mooring, "when poor *hypnorum* was quickly carried to the surface again by the air it had taken in."* Mr. Musson, further, mentions having observed spinning both by *P. hypnorum* and *P. fontinalis*†; and Mr. Standen, who refers to *P. fontinalis*, has obligingly informed the writer of observations made by him. The last-named naturalist remarks particularly upon the junction of the thread with the

* Jeffery, 'Journal of Conchology,' iii. (1882), pp. 310–1.

† Musson, *l. c.*

surface of the water, stating that the point of attachment is plainly visible, especially when the sun's rays fall upon the water of the tank in which the animals are kept; he compares the cupping of the surface-film (which can be conveniently examined with a lens) to a small inverted parachute, and states that it is shown to perfection when affected by the jerking motions of an ascending Snail. The accompanying diagram, based upon the observations here stated for *Physa*, will serve, in a general way, to illustrate the use of threads by aquatic Pulmonates. (Fig. 3.)

OPISTHOBRANCHIATA.

Suborders Tectibranchiata and Nudibranchiata (Sea-Slugs). Of Tectibranchs, only one family—*Philinidæ*—is here represented; and that only by the following note by Mr. Spence Bate :—

"The fact, observed by Mr. Warington, of the power of the *Limnæus* to move from one place to another by means of a mucous suspending cord, I have observed also to be the case with *Bulla aperta* [*Philine aperta*] in the vivarium of my friend Mr. Smyth; but the power of secreting the mucus, which is exuded from the external surface of the animal, is limited in its continuance; to prove the fact, we raised it three times to a glass shelf in the vivarium; the last time, not being able to secrete the ladder, it fell head over heels, and therefore lost the power of choosing its place below, as it could do when it came down by the cord." *

In the Nudibranchs (typical Sea-Slugs) the production of a thread has been noted in at least four families, and is perhaps general. As the creatures are not ordinarily lighter than water, they do not spin upward threads; like *Limax*, like the *Philine* just noted, and, like most other gastropods, they produce their mucus-lines during descent. While crawling at the surface of water, Alder and Hancock state:—"The Nudibranchs occasionally drop suddenly down, suspending themselves from the surface by a thread of mucus, which is fixed to the tail or posterior extremity of the foot. In this way they will let themselves gradually down to the bottom, or remain some time pendent in the water without apparent support; for the thread of mucus is so transparent that it can scarcely be seen. When carefully looked for, however, it can always be perceived, originating in the track of mucus left on the surface by the animal, the mucus forming a small inverted

* Bate, 'Annals and Magazine of Natural History' (2), xv. (1855), p. 131.

cone at the point from which the thread issues, and here slightly dimpling the surface of the water."* It appears, from an observation by Gray on *Elysia*, that the suspensory thread can be subsequently ascended by the animal.

Polyceridæ.

Thompson states that three Sea-Slugs believed to pertain to *Polycera quadrilineata*,† kept in a phial of sea-water, were generally seen suspended by their threads from the surface, the body at the same time moving freely about with much grace.‡ *Polycera lessonii*, Alder and Hancock mention, may be seen, in captivity, for hours together, "suspended by a film of mucous matter from the surface of the water."

Doridida.

Chromodoris amabilis§ (Ceylon), according to Kelaart, sometimes creeps at the surface, and "when touched with a feather it adheres by its foot, and can be kept dangling in this position by the aid of the mucous thread secreted by the surface of the foot."‖

Eolidida.

Mr. Sinel mentions having frequently observed *Eolis* hanging by a thread from the water-surface, the suspended animal having the body doubled up, Hedgehog-like, with the back downwards.¶ The writer learns from Mr. Hornell that the animal thus referred to by his colleague is *Facelina coronata*.** The thread, Mr. Hornell states,†† is sometimes 4–5 in. in length.

Elysiidæ.

Elysia viridis,‡‡ from Swanage Bay, kept by Gray in a vase, usually rested, attached by the tail to the glass, with the body

* Alder and Hancock, *op. cit.* p. 21.

† *P. quadrilineata* v. *nonlineata*.

‡ Thompson, 'Annals of Natural History,' v. (1840), p. 92.

§ *Doris amabilis*.

‖ Kelaart, 'Annals and Magazine of Natural History' (3), iii. (1859), pp. 294–5.

¶ Sinel, 'Journal of Marine Zoology,' i. (1894), p. 32.

** *Eolis coronata*.

†† Hornell, 'Journal of Marine Zoology,' ii. (1896), p. 59.

‡‡ *Aplysiopterus viridis*.

freely extended into the water, and the mantle-edges expanded; when the vase was moved or otherwise shaken, the animal contracted the mantle over its back, and descended "head foremost, as it were dropping down to the bottom, leaving a mucous filament attached to the glass"; subsequently, Gray adds, it ascended by the filament, rising thus towards the surface, and becoming attached to the glass as before.*

Limapontiidæ.

A supposed planarian-worm, *Planaria variegata*—probably a *Limapontia*†—was observed by Dalyell to be liable, in crawling up the side of a vessel, to drop to the bottom, its descent being apparently retarded, the observer says, by an invisible thread.‡

ASPIDOBRANCHIATA.

In the whole of the Aspidobranchiata we have but a single observation, and this, it is said, requires confirmation. It is not surprising that no case of spinning occurs among the Limpet and Limpet-like families; but the absence of records for the land operculates of the order—*Helicina*, &c.—is less easy to understand, especially in view of the fact that several of the land operculates regarded as Pectinibranchiata are known to suspend themselves. The Aspidobranch said to be a spinner is our little fresh-water nerite (*Neritina fluviatilis*), whose name appears in this capacity in most of the books; its only claim to notoriety in this respect, however, rests upon the fact that it was listed by Mr. Warington (with several air-breathing Water-Snails) as having been observed by him to spin.§ No particulars are given, and it is supposed by Mr. Tye that the observer may have been mistaken.‖

* Gray, 'Annals and Magazine of Natural History' (3), iv. (1859), pp. 239–40.

† Johnston, 'Catalogue of the British Non-parasitical Worms in the British Museum,' 1865, p. 12.

‡ Dalyell, 'The Powers of the Creator displayed in the Creation,' ii. (1853), pp. 115–6.

§ Warington, 1854, *l. c.*

‖ Tye, 1874, *l. c.*; 1878, *l. c.*

PECTINIBRANCHIATA.

In Pectinibranchiata the spinners occur chiefly among the mainly phytophagous kinds, which live on seaweed growing near the shore or floating on the surface of the ocean, on aquatic plants in brackish and fresh water, and on branches and aerial roots of trees, bushes, &c., by the water's edge and on land; we have also a few notes for kinds living on rocks, coral, &c.; as well as for others whose habitats afford less facilities for the exercise of the faculty. Among the notoriously carnivorous Sea-Snails, Whelks, Murices, Purples, &c., we have no observations; nor have we any for the Volutes, Olives, Harps, Cones, &c.; among the Mitres, we have one known spinner; and among the Cowries, one. Some of these animals are of large size, but nearly all those with which we are concerned are small, or of moderate growth. These creatures, like other spinning molluscs (except air-breathing Water-Snails), are generally heavier than the medium in which they live, and thus they spin during descent; the threads in many cases are doubtless used for purposes of locomotion; in other cases, however, their chief function seems to be the retention of animals liable to be shaken from their supports during high waves and winds; in still other cases the threads appear to serve chiefly as means of attachment and suspension during repose, the creatures being upheld at this time sometimes by one and sometimes by several or many threads. Most spinning Pectinibranchs, no doubt, are able to ascend to their former positions by crawling up the suspensory thread; this has been observed in *Litiopa*, in *Valvata*, and perhaps in *Rissoa*.

In the molluscs above considered—air-breathing Water-Snails and Sea-Slugs—the threads are doubtless of the nature of those of *Limax*, being derived from anterior glands, and representing the mucus-trail of ordinary locomotion. The same is probably the case with some of the spinners of the present order; but the writer is doubtful on this point, for the foot in Pectinibranchs, often of peculiar construction, serves for locomotion, differing somewhat from that with which we are familiar in other gastropods. In some cases figures of the foot show conspicuously the long transverse slit-like opening of an anterior pedal gland,

whence the mucus of the thread might presumably be derived. In many Pectinibranchs, however, in addition to the anterior gland, a ventral pedal pore exists in the median line of the anterior half of the foot-sole; it forms the opening of a cavity said to be comparable to the byssal-cavity of bivalves, and from it, externally, a well-marked groove often runs to the tip of the tail. It can hardly be doubted that the threads, in many Pectinibranchs, are derived from this ventral pore; in *Cerithiopsis tubercularis*, for instance, Jeffreys appears to have clearly seen the thread issue from "the opening in the centre of the foot-sole"; a narrow but deep groove extends from this opening to the tail, and Jeffreys tells us that it is by the tip of the tail that this animal attaches its thread to an object of support.

Cyclophoridæ.

In Borneo, the writer was informed by Mr. Everett, certain land-operculates of this family, species of *Alycæus*, have the habit of suspending themselves, by a single thread, beneath overhanging ledges of the limestone rocks on which they abound. Mr. Everett often saw numbers hanging in this way, during rest, by threads which, to the best of his recollection, were sometimes an inch long; the habit, he adds, may "save them from the attacks of such foes as, for instance, Land-planarians, which are most frequently to be found in the same situations as these Mollusca, and which I have observed to prey on small Helices, which, however, have not the protecting operculum of the *Alycæi*." That molluscs thus escape certain enemies seems highly probable, and it is perhaps a mistake to suppose that operculates are already sufficiently protected; for Lucas, in Algeria, observed that numbers of *Cyclostoma voltzianum*, in spite of the operculum, are destroyed by the larvæ of a *Drilus*.*

According to Swainson, "*Megalomastoma suspensum*, Guilding," is often found suspended by glutinous threads; and the remark is illustrated by a woodcut showing a shell of considerable size hanging from a twig by threads of moderate length, thirteen to fourteen in number, arranged upon the twig in four groups, but all proceeding from one point from between the operculum

* Petit de la Saussaye (quoting Lucas), 'Journal de Conchyliologie' iii. (1852), p. 100.

and the outer lip of the shell. (Fig. 4.)* From the fact that Guilding lived at St. Vincent, the creature is probably West Indian; but unfortunately no description of it has been published, and its identity cannot be ascertained. The information and figure were probably derived from Guilding's unpublished papers, of which Swainson is known to have made use. The figure, perhaps worked up from a rough sketch not intended for publication, is probably inaccurate, and much enlarged; it does not appear to represent *Megalomastoma antillarum*, Sowerby, or *M. guildingianum*, Pfeiffer, to which names "*Megalomastoma suspensum*" has been referred; and Mr. E. A. Smith (British Museum), who has obligingly considered the figure for the writer, thinks that it represents, possibly, *Cistula lineolata*, a small West Indian shell, of which the Museum acquired unnamed specimens at the sale of Guilding's collection. If this be the case, of course, our spinner belongs not to the present, but to the following family.

CYCLOSTOMATIDÆ.

In some notes forwarded to 'Loudon's Magazine' in 1831, Guilding mentions a "*Cyclostoma*" common in the Virgin Islands, which, having given out a mucous thread, closes the operculum, and swings by the thread when hardened by the air, safe from ants and other enemies.† This note was received in the year preceding that of Guilding's death, and, as he does not mention any other thread-making operculate, the writer presumes that this "*Cyclostoma*" is identical with the "*Megalomastoma suspensum*." In this case, in the circumstances just mentioned, the creature is possibly a *Cistula*; and we find it stated by Mr. R. J. L. Guppy that *Cistula aripensis* ‡ (Trinidad) frequently suspends itself by two or three glutinous threads from branches, or from the under surface of leaves.§ Mr. Guppy, replying to an enquiry, has had the kindness to inform the writer that this little shell, ½–¾ in. long, is the only mollusc known to him in Trinidad

* Swainson, 'Treatise on Malacology,' 1840, p. 186.

† Guilding, 'Loudon's Magazine of Natural History,' ix. (1836), p. 195.

‡ *Adamsiella aripensis.*

§ Guppy, 'Annals and Magazine of Natural History' (3), xvii. (1866), p. 45; 'Proceedings of the Scientific Association of Trinidad,' i. (1866), p. 31.

to hang suspended, and that the threads are sometimes of considerable length. *Chondropoma dentatum** (Key West), a shell about half an inch long, is stated by Binney to spin a short thread, and hang suspended by it during rest; and at the end of one of his chapters the author gives a small woodcut, which, though not described, evidently represents this shell, slightly enlarged, hanging by a short thread from a leaf-stalk; the thread, according to the drawing, proceeds from between the operculum and the outer lip of the shell, considerably nearer to the umbilicus than to the suture. (Fig. 5.)†

Another species, *Chondropoma plicatulum*, a little larger than the last, was obtained by Dr. J. S. Gibbons, at Puerto Cabello, hanging suspended during repose by a thread $\frac{1}{3}$–$\frac{1}{2}$ in. long, very thin, but strong, flexible, and silk-like; the thread issued from between the operculum and the outer lip, two-thirds of the latter's length from the suture, a position similar to that shown in Binney's drawing.‡ Similar suspension was observed by Dr. Gibbons also in the allied *Tudora megacheila*. Near St. Ann's, Curaçao, on a waste piece of ground which appears to have been a kind of conchologist's paradise, he found this creature in great abundance, "suspended by its silk-like thread from *Acacia* boughs, or strewed thickly along the ground underneath"; the thread resembled that of *Chondropoma plicatulum*, but was shorter.§

Among Old-World *Cyclostomas*, we have a note relating to *Cyclostoma articulatum*, a shell of considerable size, belonging to Rodriguez (Mascarene Islands):—"When it retired and closed its shell," says Woodward of a specimen kept under a bell-glass, "it still adhered, and sometimes became suspended, by a

* *Cyclostoma dentatum.*

† Binney, 'Terrestrial Air-breathing Mollusks of the United States,' ii. (1851), pp. 347–9; and see also W. G. Binney, 'Land and Freshwater Shells of North America,' 1865, pp. 96–7, fig. 194 (Smithsonian Miscellaneous Collections, vii.); and Tryon, 'American Journal of Conchology,' iv. (1868), p. 11; pl. xviii. fig. 15.

‡ Gibbons, 'Journal of Conchology.' ii. (1879), p. 134; and in Tye, 'Quarterly Journal of Conchology,' i. (1878), p. 412.

§ Gibbons, 'Quarterly Journal of Conchology,' i. (1878), pp. 411–2; and Tye, *l. c.*

tenacious thread of mucus."* It would have been interesting to have had more particulars of this attachment, for, according to Dr. Gibbons, the South African *Cyclostomas* fix their shells by a brittle pellicle of dried mucus, proceeding from the edge of the columellar lip, a mode of attachment, as he states, wholly different from that of *Chondropoma* and *Tudora*, whose flexible silk-like thread, as just mentioned, passes between the outer lip and the operculum.†

Littorinidæ.

Gray has listed *Littorina* with Pectinibranchs capable of making threads,‡ but the writer does not know on what authority. For repose, out of the water, most of these Periwinkles closely fix their shell by a pellicle of dry mucus, compared by Gibbons to that of the Old-World *Cyclostomas*, and by Jeffreys and others to the attaching film of *Helix*.§ Of *Lacuna*, however, which belongs to this family, Jeffreys states that the creatures "occasionally secrete slimy threads (like the *Limax arborum*), by which they suspend themselves from the frond or stalk of a seaweed."‖

Rissoidæ.

The use of threads is presumably general among *Rissoidæ*—small, often minute molluscs, which swarm on seaweeds and grasswrack in pools and shallows, as well as on and under stones in some of the deeper waters of the coast. It was in 1833 that Gray made an often quoted observation to the Zoological Society of London, that "the animal of *Rissoa parva* has the power of emitting a glutinous thread, by which it attaches itself to floating

* Woodward, 'Proceedings of the Zoological Society of London,' 1859, p. 204; and 'Annals and Magazine of Natural History' (3), iv. (1859), p. 320.

† Gibbons, 1878, *tom. cit.* p. 339; 1879, *l. c.*

‡ Gray, 'Annals and Magazine of Natural History' (2), ix. (1852), p. 216.

§ Gibbons, 1878, *l. c.*; 1879, *l. c.*; Jeffreys, 'British Conchology,' iii. (1865), p. 363; Bouchard-Chantereaux, 'Mémoires et Notices de la Société d'Agriculture, du Commerce et des Arts, de Boulogne-sur-Mer, 1835, pp. 155–7; Gray, 'Proceedings of the Zoological Society of London,' 1833, p. 116; A. d'Orbigny, 'Histoire Naturelle des Iles Canaries: Mollusques,' 1839, p. 79.

‖ Jeffreys, *tom. cit.* p. 343.

seaweeds, and is enabled, when displaced, to recover its previous position";* and we find it is stated by Jeffreys, for *Rissoa* generally, that the foot is grooved down the middle for about half its length towards the tail, whence it emits a glutinous thread, by which the animal suspends itself to foreign bodies or to the surface of the water.† "Lying on a rock by the brink of a seaweed-covered pool left by the receding tide," says Jeffreys, writing of *Rissoa parva*, "it is no less pleasant than curious to watch the active little creature go through its different exercises—creeping, floating, and spinning."‡ By "floating" the author means, evidently, creeping at the surface of the water, a habit which here, as in other molluscs, seems intimately associated with that of "spinning." The same naturalist mentions the latter habit in several other species: *Rissoa membranacea*, he says, "occasionally floats, or suspends itself by a viscous thread"; *R. vitrea* "suspends itself by a single byssal thread, keeping the mouth of the shell closed by the operculum"; *R. abyssicola* "floats like its congeners, and suspends itself in the water by a single byssal thread"; *R. pulcherrima*, exceedingly agile both in creeping and floating, "spins a delicate thread of attachment"; and the very tiny *R. fulgida* was frequently observed by the author "spinning a fine transparent slimy thread, and thus hanging suspended to a bit of seaweed or to the surface of the water." *R. cancellata*, Jeffreys further says, "is active and bold, floats like its congeners, and spins a byssal thread instantly on being detached from a crawling position"; *R. carinata*,§ moreover, like *R. cancellata*, "adheres with some tenacity to the stones on which it is found, and, when detached, it also spins a fine byssal thread, by means of which it suspends itself in the water."‖ This last species,¶ according to Mr. Brockton Tomlin's experience in the Channel Islands, is usually found under rather deeply-buried stones, to which it moors itself, he says, by a strong "byssus";** each individual, this observer obligingly tells the writer, had more than one short thread, generally, as far as he remembers, four or five. *Barleeia rubra*, according to Jeffreys, creeps at the surface, foot uppermost,

* Gray, 'Proceedings of the Zoological Society of London,' 1833, p. 116.
† Jeffreys, *op. cit.*, iv. (1867), p. 1. ‡ Jeffreys, *tom. cit.*, pp. 25, 26.
§ *R. striatula*.. ‖ Jeffreys, *tom. cit.*, pp. 6, 10, 20, 32, 41, 43, 44.
¶ *R. striatula:* ** Tomlin, 'British Naturalist,' iii. (1893), p. 123.

like the *Rissoæ*, and occasionally secretes a slight mucous filament, by which it suspends itself from the surface of the water or from seaweeds.*

HYDROBIIDÆ.

Lindström (1868) has referred to the spinning of a mucus-thread (by which the animal, with half-closed operculum, keeps itself suspended from the water-plants) as a character, among others, tending to associate the fresh-water *Bythiniæ* with the estuarine Hydrobiids.† *Bythinia*, now always regarded as a Hydrobiid, is certainly a spinner, Mr. Tye having seen *Bythinia tentaculata* suspend itself, usually after "floating," the thread being attached to the surface of the water;‡ but the writer is not acquainted with observations on other members of the family. In 1894 I kept several specimens of *Hydrobia ulvæ* and one of *H. ventrosa* under observation for ten days, in a vessel of water with weed, &c.; they often "floated" (crept at the surface of the water), but were not seen to suspend themselves.

SKENEIDÆ.

Skenea planorbis, according to Jeffreys, "occasionally suspends itself in the water by spinning a viscous thread with its foot."§

JEFFREYSIIDÆ.

Jeffreysia diaphana, also, according to the same author, "spins a slimy suspensile thread."‖

LITIOPIDÆ.

Litiopa melanostoma, a small, more or less *Rissoa*-like creature (less than a quarter of an inch in length of shell), an inhabitant of the gulf-weed of the mid-Atlantic (Sargasso Sea), is perhaps the most notorious of all the spinning molluscs. Its history is briefly as follows:—

(1). Bélanger discovered the creature in 1826, and made a number of observations on its habits; and, on his return to France, read his notes to Rang, at the same time handing him

* Jeffreys, *tom. cit.*, p. 57.
† Lindström, 'Om Gotlands nutida mollusker,' 1868, p. 26.
‡ Tye, 1874, *l. c.*; 1878, *l. c.*
§ Jeffreys, *tom. cit.*, p. 66. ‖ Jeffreys, *tom. cit.*, p. 60.

spirit specimens, and suggesting for the animals (regarded as belonging to two species), the names of *Bombyxinus melanostoma* and *B. uva.*

(2). Rang, from information thus obtained, drew up a memoir, and published it in 1829. He disregarded Bélanger's MS. names, however, and described the shells as *Litiopa melanostoma* and *L. maculata.**

(3). Bélanger (1833 ?), dissatisfied with Rang's account, gave full details of his observations, the name *Bombyxinus* being here published for the first time.†

(4). Kiener (1833) restated Bélanger's observations, and united the two supposed species as *Litiopa bombix.*‡

(5). Eydoux and Souleyet, during the voyage of the 'Bonite,' re-collected specimens from the gulf-weed, and are believed to be the only naturalists, other than Bélanger, who have published observations on the living animal. This they did in 1839.§

(6). Naturalists agree that the two forms should be united; but Kiener's name is inadmissible (as also are those of Bélanger, over which the names of Rang have priority of publication). The creature—with *Litiopa maculata* among the synonymy—is now known as *Litiopa melanostoma.*

(7). Nearly all the books contain accounts of the animal's spinning habits. These, however, are derived from Rang and Kiener (without reference to the original notes of Bélanger and Eydoux and Souleyet); the information is thus unsatisfactory; and the tale, being an often-told one, has grown considerably.

Bélanger's notes have the form of extracts from a log, and are evidently the result of careful observation. It was on June 26th that the creature first came up with the gulf-weed, and, on shaking the weed to make the animals fall, Bélanger observed that some remained suspended, at a considerable distance, by an

* Rang, "Notice sur le *Litiope* (*Litiopa*), genre nouveau de Mollusque gastéropode," 'Annales des Sciences Naturelles,' xvi. (1829), pp. 303–7; and 'Manuel de l'Histoire Naturelle des Mollusques,' 1829, pp. 26, 197, 198.

† Bélanger, "Sur les Litiopes (*Litiopa*, Rang), ou Bombyxins (*Bombyxinus*, Bélanger)," Lesson's 'Illustrations de Zoologie,' 1831: appendix (1833 ?).

‡ Kiener, "Quelques Observations sur le genre *Litiope* de M. Rang," 'Annales des Sciences Naturelles,' xxx. (1833), pp. 221–4.

§ Eydoux and Souleyet, "Observations sur le genre *Litiope*," 'Annales Françaises et Etrangères d'Anatomie et de Physiologie,' iii. (1839), pp. 252–6.

imperceptible thread like that of a small Spider. The thread proceeded from the foot of the mollusc. When the foot was touched with the finger, a thread was drawn out as the finger was slowly moved away, and when the finger was lifted in the air the animal remained suspended to it for a long time, and for a great distance—more than three feet; even when moved about considerably, and otherwise somewhat severely tested, the creature did not fall; and more than a score were experimented upon, always with the same result. The animal—in some at least of these cases—hung, not in its native element, but in the air. On June 28th and 29th more weed inhabited by this animal was fished up, and Bélanger again observed the creature's spinning habits.* Speculating upon the use of the thread, he remarks that the creature, born, living, and reproducing on floating weed, incessantly tossed with more or less violence by the very deep ocean, would be lost, when detached by a wave, had it not this faculty of spinning a silk which, like a cable, holds it to its habitat. On July 8th further weed was fished up, but the molluscs were now less numerous; and, having been out of the water some time when experimented upon, but few remained suspended after the weed had been shaken. Providing himself with a bucket of sea-water, however, Bélanger was able to make several observations; some of the animals adhered to his finger, and hung therefrom, both in the air and in the water. An individual which had lowered itself from the weed, on being placed in the water, remained suspended, and, though moved from one side of the bucket to the other, made to sink to the bottom and lifted up again, it still retained its hold. At length the observer allowed the weed to float on the surface, and after some time, to his great satisfaction, he saw the animal ascend by its thread, and replace itself upon the frond from which it had been suspended. Others which were at the bottom of the bucket, on being moved with a branch of weed, attached their silk to it;

* The author refers also to a bundle of weed, containing a quantity of eggs, supposed, no doubt erroneously, to be those of *Litiopa*. The eggs were united by numerous threads similar to those of the mollusc; each egg was attached by a particular thread, and the whole mass was so strongly fastened together that it was with difficulty that a part was detached. This structure, it can hardly be doubted, was the "nest" of the little Gulf-weed Fish, *Pterophryne*.

and when the branch was left floating at the surface some ascended to it by the thread, while others fell again to the bottom. Another observation, which the author regarded as of much interest, was as follows:—He saw issue from two or three of those which were at the bottom of the bucket a little bubble of air, which rose slowly; and, in trying to move it with a frond of the weed, he saw the animal—holding to the bubble by means of its silk—rise through the water. Speculating upon this last observation, Bélanger supposes that the creature would not be entirely lost even if the shaking, which had detached it from the weed, were also strong enough to break its thread; though not anchored it would still have a lifebuoy, and this buoy, floating on the surface of the water, and coming in contact with another plant, would enable the animal to ascend to a new home. Further, the author even thought it possible that the creatures might thus voluntarily change their positions; a family, he supposes, might find their plant insufficient to feed their increasing numbers; whereupon some of them, seeking new feeding-grounds, might abandon themselves to the water, and wait, suspended to their bubbles, till a new plant chanced to be carried to them by the waves. Finally, on Aug. 27th, the creature still occurred on the weed, but in small quantity, and mostly very young. Of those which remained suspended after the weed had been shaken, one of the larger ones was observed, while thus hanging in the air, to reascend by its thread. Placing the animals at the bottom of a bucket of water, the observer left them for the night; but in the morning all were dead, none having ascended to the surface or to the floating weed. Eydoux and Souleyet obtained numerous specimens, and, on shaking the weed on which the animals were brought up, they had no difficulty in confirming Bélanger's statements about the suspensory thread. They appear to have been at considerable pains, however, in attempting, unsuccessfully, to confirm the observations about the mucus-invested air-bubble; specimens were placed at the bottom of deep vessels of water, and allowed to remain there for a considerable time, but none ascended by means of a bubble. Some crept up the sides of the vessels to the water-surface, under which they crept like other gastropods. The appendages which characterize the upper part of the foot of *Litiopa* may be useful, these authors think, in

helping to keep the animal at the surface. Notwithstanding Rang's remark that the thread is doubtless formed of a special secretion, Eydoux and Souleyet think it probable that it consists merely of locomotory mucus, which, in these molluscs, may possibly possess special characters. Rang, it may be added, while examining spirit specimens, found, under the foot, a little glairy mass, which attached itself to the point of the scalpel, and was easily drawn out into a thread a foot and a half long; each specimen presented the same peculiarity, and Rang concluded that this was the substance from which the thread is made; it seems more probable, however, that the little masses were the remains of threads already spun, and perhaps reascended by the animal.

The above, the present writer believes, is all that is known of the spinning habits of *Litiopa*. These habits are certainly of a surprising character: the length of the apparently rapidly made thread, the animal's security upon it, and the facts that it can produce and afterwards ascend by it, not only in its native element, but also in the air, are points of special interest. As to the statements in the books, one may quote, for example, from Johnston's 'Introduction to Conchology':—

"The habits of the *Litiopa* are not less worthy of your notice. This is a small Snail, born amid the gulf-weed, where it is destined to pass the whole of its life. The foot, though rather narrow and short, is of the usual character, and, having no extra hold, the Snail is apt to be swept off its weed; but the accident is provided against, for the creature, like a Spider, spins a thread of the viscous fluid that exudes from the foot to check its downward fall, and enable it to regain the pristine site. But suppose the shock has severed their connexion, or that the *Litiopa* finds it necessary to remove, from a deficiency of food, to a richer pasture, the thread is still made available to recovery or removal. In its fall, accidental or purposed, an air-bubble is emitted, probably from the branchial cavity, which rises slowly through the water, and as the Snail has enveloped it with its slime, this is drawn out into threads as the bubble ascends; and now, having a buoy and ladder whereon to climb to the surface, it waits suspended until that bubble comes into contact with the weeds that everywhere float around!"*

* Johnston, 'Introduction to Conchology,' 1850, p, 134; with references to Rang and Kiener.

The speculations of Bélanger, it will be observed, here appear as statements of established facts, Johnston having been misled by Kiener, whose restatement of Bélanger's observations wants some of the precision of the original notes. Statements in other books (some adapted from Johnston) also exceed what is really known; and some are further objectionable from the fact that they do not make it clear that suspension is likely to be an occasional circumstance, not the usual condition under which the animal lives.

Alaba picta, a Litiopid found by A. Adams among *Zostera* in shallow water in the seas of Japan, is stated by him to spin a pellucid thread, with great rapidity, from a viscous secretion "emitted from a gland near the end of the tail"; it also creeps at the surface of the water, and, when fatigued, suspends itself, apex downwards, by means of the thread which is attached to the surface.*

VALVATIDÆ.

Valvata piscinalis (familiar in our ponds and canals) was observed to use a thread by Laurent. He noticed that the animals, in crawling at the surface of water, deposited there a trail of mucus, and that, when made to fall, some of them remained suspended to the floating trail by a thread; similarly, others were sustained in the water when forced to leave the branches of the plants on which they lived. In the former case some were seen to remount to the surface of the water by ascending their thread, which was gathered up by the foot.† Mr. A. E. Boycott has written of the same animal, immature specimens of which, in captivity, were seen by him actively engaged in thread-spinning:—"Their usual mode of procedure was to crawl up the side of a glass vessel nearly to the surface of the water; they then gave one or two twisting motions, and crawled out on the under surface of the water, leaving a thread joining them to their point of departure. They then either sank slowly, remained floating, or sank about half way, where they stopped." The thread, the presence of which was easily demon-

* A. Adams, 'Annals and Magazine of Natural History' (3), x. (1862), pp. 293–5, 419.

† Laurent, 'Extraits des Procès-Verbaux des Séances de la Société Philomatique de Paris,' 1841, pp. 118–9.

strated with a pin, was in most cases sufficiently strong to enable the observer to raise the animal to the surface, but not out of the water.*

Cypræidæ.

Our little Cowry (*Cypræa europæa*) makes considerable use of a thread, a fact first noticed by Charles Kingsley, who wrote to Gosse, in 1854, that he had seen the animal suspend itself from the under side of low-tide rocks by a glutinous thread an inch and more in length; in captivity, further, he saw it "float on the surface by means of a similar thread attached to a glutinous bubble."† According to a paper by Mr. L. St. G. Byne, the animal is occasionally seen at Teignmouth, hanging by its "byssus" on the rocks at low tide.‡ This statement, as the writer learns from Mr. Byne, is made on the authority of a reliable collector, who mentions, amongst other things, that on lifting a boulder he saw one of these molluscs hang from it by a thread 4–5 in. long. Mr. Hornell, from observations made presumably at Jersey, writes in an interesting manner on the same subject. In confinement in a tank, he says, the little animal frequently crawls foot-uppermost along the surface of the water, and occasionally may be seen to form a little disc of mucus, from which it lowers itself gently by a mucous thread till it hangs in mid-water, dangling in the fashion of a Spider at the end of its silken cord. "This habit of the Cowry is to be correlated," Mr. Hornell adds, "to that more familiar and natural one so readily verified by any observer who visits the low-tide caves and gullies where, amongst Sponges and Ascidians, this animal loves so to live. Here, when the tide recedes, Cowries more or less enveloped in their bright-coloured mantle robes are often seen passively hanging suspended from the gully's roof, or from points and jutting ledges, by a stout mucous thread."§

Cerithiidæ.

In this family we have notes on a *Bittium*, a *Cerithiopsis*, and

* Boycott, "*Valvata piscinalis* as a Spinner," 'Science Gossip' (n.s.), ii. (1895), p. 82.

† 'Charles Kingsley; his Letters and Memories of his Life,' edited by his Wife, ed. 3, i. (1877), p. 408.

‡ Byne, 'Journal of Conchology,' vii. (1893), p. 187.

§ Hornell, 'Journal of Marine Zoology,' ii. (1896), pp. 59–61.

a *Cerithidea;* general statements occur in the books also for *Cerithium* and *Potamides*, but these rise out of synonymy, the animals referred to being respectively *Bittium* and *Cerithidea*. Our little *Bittium reticulatum*,* according to Jeffreys, "crawls actively and quickly by means of its long foot, and occasionally suspends itself by a byssal filament to a bit of floating seaweed, or to the side of the vessel in which it is kept."† *Cerithiopsis tubercularis*, another little mollusc of our coasts (shell generally about ¼ in. long), resembles the *Bittium* in its active crawling habits. "When at rest," according to Jeffreys, "it spins a fine transparent thread, which issues from the opening in the centre of the foot-sole, its end being attached by the point of the foot to some foreign substance." The author, on one occasion, drew the shell up by the thread with a camel's-hair brush, and kept the creature thus suspended in the water for several seconds, the foot being doubled up.‡ *Cerithidea obtusa*,§ which is a mollusc of good size, presents one of the most curious of the cases noticed in this paper. It lives in brackish water, in mangrove-swamps, and the mouths of rivers in Singapore and Borneo; sometimes it crawls on stones and leaves in the neighbourhood, and, according to the observations of A. Adams, it is not unfrequently found suspended by glutinous threads to boughs and the roots of the mangroves, as represented in fig. 6. Further, according to the same observer, "when the animal hybernates, it retracts itself into the shell, and brings its operculum to fit closely into the aperture, after having previously affixed sixty or seventy glassy, transparent, glutinous threads to the place of attachment, when they occupy the outer or right lip and extend half-way round the operculum."‖ Von Martens has observed that the attachment of this mollusc and of "*Megalomastoma suspensum*" (fig. 4) make a remarkable approach to the attachment of bivalves by a byssus,¶ but this remark, the writer pre-

* *Cerithium reticulatum.*

† Jeffreys, *tom. cit.* p. 260. ‡ *Ibid.* p. 268.

§ *Cerithium truncatum*, *C. obtusum.*

‖ A. Adams, 'Zoology of the Voyage of H.M.S. Samarang: Mollusca,' 1848, pp. 43–4; and see also 'Narrative of the Voyage,' ii. (1848), pp. 389, 509; 'Proceedings of the Zoological Society of London,' 1847, pp. 21–2; and 'Annals and Magazine of Natural History,' xix. (1847), pp. 413–4.

¶ E. v. Martens, 'Zoologischer Anzeiger,' i. (1878), p. 251.

sumes, refers merely to the appearance of the figures; for nothing appears to be known of the manner in which the threads are produced and attached. Adams's observations are referred to in nearly all the books, and figures based on his are found in Woodward and in Keferstein, that of the former having been repeated by Fischer and twice by Tryon.* Mr. Tye, who refers to Woodward, has by mistake attributed the observations to *Cerithidea decollata*,† an animal which does not appear to fix itself by threads, Dr. Gibbons having reported that large numbers seen by him on trunks of marsh trees in Natal were attached, not by threads, but by "a trifle of brittle mucus passing from the lip to the tree," a mode of attachment, as Dr. Gibbons says, resembling that of brackish water *Littorinæ*.‡

Planaxidæ.

Planaxis has been listed among thread-making molluscs by Dr. Macdonald,§ but the writer does not know on what authority.

Solariidæ.

According to Mr. Harper Pease, two forms of *Torinia* (Hawaiian Islands) "suspend themselves by strong gelatinous threads, one of which will sustain the weight of several shells, and can be drawn out four or five inches"; the creatures are found almost invariably upon branched coral. ||

Pyramidellidæ.

Among the crowd of little conical-shelled molluscs of the genus *Odostomia*, the use of a thread has been observed by Jeffreys in *Odostomia warreni*, whose foot is remarkable from being forked at the extremity like the tail of a Swallow. The

* Woodward, 'Manual of the Mollusca,' 1851, fig. 78; Keferstein, 'Bronn's Klassen und Ordnungen des Thier-reichs,' iii. (1862–6), pl. lxxxii. fig. 9; Fischer, 'Manuel de Conchyliologie,' 1884, fig. 449; Tryon, 'Structural and Systematic Conchology,' ii. (1883), pl. lxx. fig. 73; 'Manual of Conchology,' ix. (1887), pl. xix. fig. 6.

† Tye, 'Quarterly Journal of Conchology,' i. (1878), p. 409.

‡ Gibbons, 'Journal of Conchology,' ii. (1879), p. 134.

§ Macdonald, 'Journal of the Proceedings of the Linnean Society': Zoology, v. (1861), p. 209.

|| Pease, 'American Journal of Conchology,' v. (1870), p. 81.

animal crept at the surface of the water like other gastropods, and one individual spun a delicate glutinous filament from the middle of the sole of the foot, and kept itself suspended for some time in the water, with the point of the shell downwards. *O. acicula*, Jeffreys adds, has the same habit. Both animals are inhabitants of our own coasts.*

Eulimidæ.

Eulima intermedia, another inhabitant of our coasts, creeps at the surface, and, according to Jeffreys, "it remains suspended in that posture by means of a byssal thread, the operculum then closing the mouth of the shell";† statements, apparently applying to the genus generally, which occur in Fischer and in Tryon,‡ have their origin presumably in this observation.

Mitridæ.

The only representative of the Mitre-shells—and of a considerable number of surrounding families—of which we have any note is the little "*Mitra saltata*," Pease—probably the young of some larger Mitrid—a native of the shores of the islands of the Central Pacific. It is described as an elegant little mollusc, found living in hollows of coral-rock; and it is certainly a creature of remarkable habits. When disturbed (Mr. Pease found) it would skip five or six inches in a horizontal line, from one side of the cavity to the other, at the same time spinning out a very fine thread; and, when held in the hand, it would jump off, suspending itself by a thread to a distance of 2–3 ft.§

Pleurotomatidæ.

Another isolated note, the last we have to give, relates to *Mangilia nebula*,‖ a little mollusc of our own coasts. The animal is exceedingly active, and the Rev. R. N. Dennis, who placed

* Jeffreys, 'Annals and Magazine of Natural History' (4), ii. (1868), p. 279; British Association Reports, 1868, p. 233; *op. cit.* v. (1869), p. 212.

† Jeffreys, *op. cit.* iv. (1867), p. 204.

‡ Fischer, 'Manuel de Conchyliologie,' 1885, p. 782; Tryon, 'Manual of Conchology,' viii. (1886), p. 259.

§ Pease, 'Proceedings of the Zoological Society of London,' 1865, pp. 512–3; and see Garrett, 'Journal of Conchology,' iii. (1880), p. 71.

‖ *Pleurotoma nebula.*

specimens in a basin of sea-water, observed that they crawled to the edge and suspended themselves by a thread.*

EXPLANATION OF PLATE III.

FIG. 1.—A Water-Snail (*Limnæa auricularia*) hanging by a thread from the surface of the water in an aquarium. After Taylor, 'Monograph of the Land and Freshwater Mollusca of the British Isles,' i. (1899), p. 318 (fig. 610).

FIG. 2.—A fresh-water Limpet (*Ancylus lacustris*) using a thread. From a sketch by Prof. Cockerell.

FIG. 3.—Diagram illustrating the use of threads by aquatic Pulmonate Molluscs, based for the most part on observations recorded for *Physa hypnorum*, by Mr. G. S. Tye. The animal is ordinarily slightly lighter than water:—A, an individual crawling through the water towards the surface, leaving its locomotory mucus behind in the form of a thread, which retains the animal, and prevents its sudden rise to the surface; B, the animal at the surface, taking in a supply of air—the thread, having been continued as a floating slime-trail, is now attached to the surface; C, the animal returning by descending its thread; another individual is making use of the fixed thread for ascent. An upward journey (A) may be abandoned, the animal in that case returning upon its unattached thread, D.

FIG. 4.—"*Megalomastoma suspensum*," a land operculate of doubtful identity, at rest, suspended by a number of threads from a twig; probably much enlarged. After Swainson, 'Treatise on Malacology,' 1840, fig. 29; presumably from a sketch by Guilding.

FIG. 5.—*Chondropoma dentatum*, a land operculate, at rest, suspended by a short thread; slightly enlarged. After Binney, 'Terrestrial Air-breathing Mollusks of the United States,' ii. (1851), p. 347.

FIG. 6.—*Cerithidea obtusa*, a brackish-water, somewhat amphibious, operculate mollusc, at rest, suspended to a bough by a number of short threads. After A. Adams, 'Zoology of the Voyage of H.M.S. Samarang: Mollusca,' 1848, pl. xiii. fig. 3 *b*.

* Dennis, in Jeffreys, *tom. cit.* p. 386.

NOTES AND QUERIES.

MAMMALIA.

In the British Gallery of the National Museum the Harvest Mouse (*Mus minutus*) is at present unrepresented, on account of the lack of specimens. I therefore venture to ask the kind assistance of readers of 'The Zoologist' in remedying this deficiency. I may add that specimens of all the British Bats, with the exception of the Noctule and the Long-eared species, are likewise wanted for the same gallery. Specimens should be forwarded to me at the Museum.—R. Lydekker (British Museum (Natural History) London, S.W.).

AVES.

Mistle-Thrush attacking Squirrel.—On April 27th last I was noticing the nest of a Mistle-Thrush (*Turdus viscivorus*) in an oak tree, when a Squirrel by chance passed along the branch on which the nest was; the female (I presume) left the nest and attacked the Squirrel violently, darting furiously at it and screeching loudly, until it had passed on to the next tree; she then squat upon a limb for a few moments, with wings partly extended and drooping, again taking possession of the nest a few minutes afterwards. —Stanley Lewis (Wells, Somerset).

Crossbills at Shrewsbury.—On June 24th and 25th a number of Crossbills (*Loxia curvirostra*) visited my garden. I counted seventeen in one place, and there were others in different parts. As most of them were young birds, I imagine they have been bred in the neighbourhood. They were wonderfully tame, feeding close to the windows on the seeds of the wych-elm, with which the lawn was covered. I may mention that a pair of these birds frequented my garden in January and February of this year. Probably they had a nest, but I could never find it.—R. H. Ramsbotham (Merle Brace, Shrewsbury).

Early Appearance of Swift.—The arrival of our summer migrants has in almost every instance been unusually late, and now (May 15th) the Swallow and the two species of Martin are not abundant: but this need not be wondered at when we consider the wintry weather that has prevailed. The Swifts (*Cypselus apus*) seem to have come in fair numbers, and, strange to say, I saw two on April 26th, which was a very early date, especially

during this exceptional spring, for this usually late visitor. In ordinary seasons it is seldom seen with us before the end of April or beginning of May. I have a record as early as April 18th. But this season everything ornithological, entomological, and botanical appears uncertain, and out of its usual order.—G. B. Corbin (Ringwood, Hants).

The Great Spotted Woodpecker in Surrey.—*Dendrocopus major* has become so rare a bird in Surrey that the successful rearing of a brood deserves to be recorded. Early in June I happened to notice a hole in the trunk of a partially decayed birch tree in an unfrequented part of the Hurt Wood, near Shere. The hole was circular, about fifteen feet from the ground, and appeared to be the work of a Woodpecker. On tapping the trunk the cries of young birds greeted my ears, and I therefore returned the following morning with a glass to watch for the old birds, and ascertain their species. After waiting about twenty minutes a female Great Spotted Woodpecker suddenly flew against the trunk, but, catching sight of me, swerved aside and retired to a small oak tree a few yards from where I sat. Here she perched upon a horizontal branch, lengthways, after the fashion of a Nightjar. She remained almost motionless (thinking apparently that she was invisible), and I was able for a quarter of an hour to examine her with my glass. She had in her bill a large bunch of insects, which, finding inconvenient, she deposited on the branch in front, but removed when taking her departure. When the male bird flew to the hole, as happened in due course, she warned him of the danger with loud and alarming cries of "quick," often repeated at regular intervals. Both birds then retired to a distance, and kept up their answering alarm-notes. After about half an hour the male flew against the further side of the birch, and peered round the side of the trunk in my direction. The young ones had by now become vociferous; but, though I remained about an hour, neither parent ventured to enter the hole. I am told that the brood was fledged a few days later. The Lesser Woodpecker (*D. minor*) may still be seen in a good many places in Surrey, and, though very shy and difficult to discover, is not so very rare. *Gecinus viridis* is abundant, and, I think, increasing in the unbuilt-over portions of Surrey.—Harold Russell (Shere, Surrey).

Hoopoe in Hants and Dorset.—From information received from friends residing in widely separated localities, both east and west, and whose descriptions could be only referable to this handsome and conspicuous species (*Upupa epops*), I infer that it has visited us in some numbers, contrary to its usual scarcity; and on May 2nd I saw a specimen which had been found dead somewhere on the borders of Dorset, apparently starved. The body was very emaciated, and one wing had been injured, as if by a stone, which must have prevented flight, and possibly was the cause of its

poor condition. I am glad to say I have not heard of a specimen having been wilfully killed, and I suppose it is too much to hope that the birds recorded were of Hampshire origin. A writer in the 'Field' of January last recorded the nesting of the species two consecutive years in South Hants, the exact localities being wisely withheld for obvious reasons.—G. B. Corbin (Ringwood, Hants).

Spoonbill at Great Yarmouth.—On June 7th a magnificent Spoonbill (*Platalea leucorodia*) was seen on Breydon, where I put it up. *Black-headed* Gulls, out of curiosity, were keeping it company, and *they* followed it to another resting place, not *he* them. I also saw two on the night of June 9th (not including the same bird), in company with *Black-backed Gulls*. Twelve were seen on June 4th for an hour or two on Breydon, and afterwards observed at Waxham.—Arthur Patterson (Ibis House, Great Yarmouth).

Hybrid Pheasant.—It is well known how readily the various species of Pheasants interbreed—sometimes even with the poultry of the farmyard—and this to such an extent that what is said to be the original stock, with dark uniform steel-blue neck and dark legs, is now seldom met with where extensive rearing is practised. Thus the size and consequent weight have in many instances deteriorated, and the plumage has become so varied that in some cases it is almost impossible to say to what particular species or "strain" in this most beautiful plumaged class of birds some individual specimens belong. I am alluding to birds in a semi-wild state, and not to those kept in confinement, for in the latter case, if I may judge from a series of skins I saw some time since, the variation in plumage is very great, especially with the Amherst and Golden Pheasant. I have heard it asserted—whether rightly or wrongly, I cannot say—that the Common Pheasant (meaning, I suppose, the hybridized bird so commonly reared) seldom interbreeds with the "Golden." In the spring of 1898 a game-keeper informed me that in one of his covers he had seen a common cock Pheasant consorting with a hen "Golden," and subsequently he found her nest, with, I believe, seven eggs in it, five of which were duly hatched. During the shooting season of 1898–9 one of these birds was killed—a cock—of such a peculiar colour that the proprietor of the shooting had it preserved and mounted. It was of a uniform reddish cinnamon, except the neck, which was of a bronze-copper shot with shades of purple. The development of its plumage was, however, normal, except the tail, which was longer than in the ordinary bird. Last season two others of the brood were killed, and, being a year older, one of them at least was more fully developed; but, although a second season's bird, it had no indication of spurs. Its tail was of the same form, but much longer than in the ordinary

cock; the two upper feathers of a pale buff, with slight indications of darker transverse markings; under feathers barred after the manner of Golden. Body: under parts uniform bright reddish brown; back more yellow, dappled thickly with ash-brown and black; neck a purple-bronze, with small portion of scarlet on cheeks. It had no crest, but the "cape" or "tippet" was represented by a number of feathers two and a half or three inches long, of a uniform rich brown colour, which hung in a pendent manner from the back of the head, thus giving the bird a very peculiar appearance.—G. B. Corbin (Ringwood, Hants).

Albatross near Faroe.—It may interest readers of 'The Zoologist,' to hear of the occurrence of another specimen of the Albatross (*Diomedea melanophrys*) in or near Faroe. Miss Elizabeth R. Taylor, who is residing in Faroe for the purpose of studying these isles and their natural and other history, writes me as follows:—"It has occurred to me that you may be interested in knowing that another Albatross has been shot near the Faroes this year (the last one being the Albatross of Mygganoes, shot in 1894). This one was shot at sea, on the Faroe Banks, about seventy or eighty miles south-west of Thorshavn. I heard of it just before I left Thorshavn, and did not ascertain any particulars, whether male or female. It is of the same species as the Mygganoes one. The taxidermist at Naalsoe is preparing the specimen now, and I suppose it will be sent to the Museum at Copenhagen." With reference to the above interesting communication, I need not refer to the previous records of the Albatross in the Faroe Seas, as these records are so recent. However, I may mention that Mr. Thomas Parkin, with whom I have been in correspondence on the subject, intends to bring out a monograph of the genus, and has already delivered a lecture upon the different species. This lecture was given before the Hastings and St. Leonards Natural History Society at the Museum in the Brassey Institute on April 10th last, and printed in the 'Hastings and St. Leonards Observer' of the 14th of that month.—J. A. Harvie-Brown (Dunipace House, Larbert, N.B.).

Migration Notes from Great Yarmouth.—The spring migration of 1900, more particularly of the Grallatores, has been, in this neighbourhood, a very disappointing one, the prevailing winds being north-east, or thereabouts, and the weather exceptionally bleak and cold. South-easterly winds are those most favourable to the visitation of the water-loving species, although any wind from the southward suits the land-birds equally well. The other side of the North Sea has no doubt seen the bulk of passing migrants, and many birds must have put off their journey until the last extremity, and then have gone on straight ahead without gossiping, as they do in favourable seasons on Breydon, resting and feeding, thus breaking

the trip. The following extracts from my note-book will give a pretty fair idea of these movements this season:—Wigeon fairly plentiful, Feb. 17th. Small bunches of Larks flying north-east, Feb. 20th. Fifty Curlews on Breydon, Feb. 27th. Flocks of Ringed Plovers on Breydon, March 1st. Sailed past several Dunlins, on March 28th, on edge of "flat"; they were as grey as in depth of winter. About two thousand Starlings on a marsh, March 28th. Late for so big an assembly. Query, were they late-hatched birds? Will they remain unnesting? Numbers of Little Auks washing ashore dead; thirty picked up last week in March; also some Puffins. Wedge-flights of Starlings moving seawards, March 29th. About one hundred Wigeon on Breydon, April 17th. Six Geese passing over (Whitefronts?), April 18th. A few Godwits reported on beach, April 17th. Sailed into flock of one hundred Wigeon, April 20th. Several Kentish and Common Crows together on Breydon mud-flats, April 20th. Five Kentish Crows on Breydon late as May 11th; one had a drooping wing; the other laggards were no doubt anxiously wishing to be off, but loath to leave him; they were gone next day. One Spoonbill said to have been seen a few hours on Breydon on April 28th; on June 7th twelve were reported to me as seen there; I was on Breydon myself, but it was so rough I went in a leeward direction, otherwise I should have gone by the very flat they were said to have rested upon for only an hour or two. I did not see them. By one or two they were mistaken for Swans, a not unusual error to those who see them at a distance. Several Grey Plovers on Breydon, May 5th; wind south-west, suddenly veering to south-east by next morning—a shift I expected. A precisely similar thing happened on May 25th, the wind backing from north-east to south-east in a few hours (*cf. ante*, p. 162). Some delightfully "Black-breasted" Plovers (old gunner's nick-name for Greys) on Breydon, May 10th; they were very tired, and I "quanted" to within a few paces and watched them. Only Knots seen, May 9th; about five or six. Seven Swifts arrived on May 11th; an early arrival. We usually expect five pairs. They vanished for a few days, it being cruelly cold, and returned again. Only very few Godwits. Saw three on May 12th; have seen only one or two others since. Saw a pair of Shovelers on May 16th; they undoubtedly nested in the vicinity, but, as they have frequently visited Breydon since, their nest may have been rifled. Saw them to-day (June 10th). Observed Whimbrel in couples, May 16th; they were numerous a week before, hunting singly or in small scattered flocks. Several there as late as to-day (June 10th). A few Yellow Wag-tails on marshes, May 16th, by no means plentiful as of yore. Saw one Turnstone, May 28th; only one I have seen. A goodly sized flock of Ringed Plovers on May 27th; a few on Breydon to-day (June 10th), possibly birds nesting on the adjacent coast; also three Dunlins, probably

non-nesters. Have seen no Terns, neither Black, Arctic, or Common. Hirundines rather numerous in adjacent villages. Cuckoos numerous; locally nesting Redshanks show no falling off this season; Common Sandpipers were fairly numerous last month. There may be nothing recorded above of any importance, but the bare summary of my observations will show how scanty has been the local record, and may serve for comparison with other districts.—ARTHUR PATTERSON (Ibis House, Great Yarmouth).

ARACHNIDA.

Rare English Ticks.—The study of Ticks (*Ixodidæ*) has been much neglected in England. Mr. E. G. Wheler, of Alnwick, has, however, recently taken up the subject, and has published, in 'Science Gossip,' a series of short papers upon some of our British species. In the hope of inducing others to take an interest in these parasites, I venture to put on record the occurrence in England of two species which have not, so far as I can ascertain, been previously recorded from this country, and of a third which is certainly not common. It is true that Mons. G. Neumann, in his recent monograph of this group, states that he has seen specimens of the first two, belonging to the Bureau of Animal Industry of Washington, that were taken off English Sheep; but whether the Ticks were collected off Sheep in England, or after their importation to America (which is a very different matter), I am unable to say. I may add that Mr. Wheler took up the study of these parasites on account of their connection with the malady known as "louping ill," which is so destructive to Sheep in some parts of England. It is known, too, that great havoc is wrought amongst cattle in the United States and our own colonies by these pestilent Arachnids; and, since there are some reasons for supposing that there may also be a causal connection between the bites of these parasites and that deadly tropical disease, "black-water fever," it is safe to predict that within the next few years there will be a boom in Ticks rivalling that in Mosquitoes at the present time. I should be grateful for any specimens readers of 'The Zoologist' may come across. They should be preserved in alcohol.

1. *Dermacentor reticulatus*, Fabr. — Specimens of this Tick were sent to the British Museum for determination by Mr. Richardson, of Stoke House, Revelstoke, Devon. Mr. Richardson writes:—"These Ticks are a pest of this immediate neighbourhood. They do not bite human beings, but punish Sheep and Dogs like the ordinary Tick. A farmer tells me they were not known here fifteen years ago, and that they appear about January, and disappear about May, being very plentiful in March and April. It is strange that they should not be known a few miles away."

2. *Hæmaphysalis punctata*, Can. and Fanz.—Specimens of this species

were taken by Mr. F. Pickard-Cambridge at Dungeness. They were found amongst the shingle on the beach, and also upon a Hedgehog.

3. *Hyalomma affine*, Neum.—A specimen (a gravid female) of this species was sent for determination to the British Museum in May, 1898, by Mr. P. C. Essex, who picked it up at Feltham. The specimen is very much larger than the ordinary British Tick, and closely resembles the so-called "Camel-Tick" of Egypt and India. My suspicion that it actually was an example of this species that had interested Mr. Essex was partially confirmed at the time by my inquiry eliciting the information that a travelling menagerie had passed through Feltham a short while before. Subsequent examination of the specimen, however, has shown that it is referable to *H. affine*, Neumann, a species which its describer mentions as common on Tortoises (*Testudo græca* and *mauritanica*), and records as taken in England off one of these reptiles. Hence there is no reason to doubt that the Feltham specimen was introduced, and is not a descendant of British-born parents.—R. I. Pocock (Nat. Hist. Museum, South Kensington).

ORGANIC EVOLUTION.

In the last copy of 'The Zoologist' which has come to hand in this out-of-the-way part of the world (Mashonaland), I find that Mr. Distant has terminated his series of deeply interesting articles on "Biological Suggestions," relating to "Assimilative Colouration and Mimicry." In these articles he has brought together a most valuable collection of observations and remarks, made by all sorts and conditions of men, upon the fascinating problems of animal colouration, a collection which bears eloquent testimony to the wide and careful reading of the author; indeed, although it may appear ungrateful to say so, the material offered for the contemplation of the reader is almost bewilderingly profuse—so much so, in my opinion, as frequently to obscure the real aim and object of the essays under a mass of citations. Thus, although many of the points raised by Mr. Distant appeared to be open to discussion, it seemed advisable to see the articles as a whole before attempting to comment on the conclusions which he suggests should be drawn from the records therein brought forward. I deal only with his remarks on "Assimilative Colouration," published in Sept. and Nov. 1898 (Zool. ser. iv. vol. ii. pp. 377 and 453).

If I have rightly comprehended Mr. Distant's meaning, his general object is to show that the theory of natural selection has been pushed too far by some of its supporters in their endeavour to explain colouring in nature, and to this end he propounds two suggestions: primarily, that "in the long past animals were uniformly and assimilatively coloured in connection with their principal surroundings" (*l. c.*, p. 461); and, secondarily, that "it is at least probable that, where we have protective resemblance in a unicolourous

condition, it is a survival of original assimilative colouration, and not a direct product of natural selection" (p. 473). The question to be considered is, whether these propositions have been sufficiently maintained.

I may here state that, so far as concerns the endeavours of some biologists to make natural selection responsible for every trifling detail of colour, I can sympathise to some extent with Mr. Distant's general attitude; as, for instance, when it is attempted to explain trivial local variations by the purely hypothetical and quite unprovable assumption that these are correlated with certain obscure but useful constitutional characters, of which we know nothing at all, on the ground that it is these characters, and not the trivial colours themselves, that have been operated upon by natural selection. Such contentions certainly do not commend themselve in the present state of our knowledge. But when one contemplates the vast mass of valuable biological work, both in arduous experiments and paisntaking observations, that has been and is still being accomplished by the champions of natural selection in order to test the validity of the Darwinian theory in every hole and corner of the organic world, one can only read with unfeigned astonishment the assertion that "the tendency to explain all problems by natural selection is to-day greatly retarding the study of bionomics. It is not one whit removed from the proferred explanation of the old teleologists, and represents as little thinking"! An endeavour to refute this assertion would be out of place here; and I need only mention, with special reference to the last phrase of the above quotation, that although the explanation on the selection theory of the inter-resemblance of distasteful insects appears simple enough at the present day, yet for twenty years it baffled the ingenuity of such men as Bates and Wallace, until Fritz Müller put forward the ingenious theory of mimicry now associated with his name.*

But to return to Mr. Distant's suggestions. We are at once confronted with a difficulty in that no definition is offered of the exact significance of the term "assimilative colouration," which is evidently loosely applied, seeing, for example, that the brilliant red on the wings of the African Touracos is given as an instance of partial assimilative colouration (p. 460),† apparently on the assumption that these birds eat copper ‡—the common copper

* Of course Mr. Marshall does not suggest that Müller's theory has found universal acceptance?—Ed.

† The exact passage to which exception is taken reads as follows: "This cannot be taken as an instance of pure, but only partial, assimilative colouration, but is sufficient to prove that colour may be largely derived from the mineral constituents of the earth's surface, and in this way can scarcely be altogether ascribed to the action of 'natural selection.'"—Ed.

‡ The "assumption that these birds eat copper" is not found on the page criticised; and is negatived by a quotation given from Mr. Monteiro (p. 459). —Ed.

ores of the country being green. We must, therefore, assume that assimilative colouration, as here understood, signifies a close similarity of colouring between an organism and its environment, due to the direct action of the latter upon the organism, either through nerve stimuli or through the direct absorption of the environment into its system, such colouring being essentially non-significant, any utility it may possess being entirely fortuitous.

The general proposition that in the earliest ages of the earth's history such assimilative colouration everywhere prevailed is a perfectly legitimate surmise, though a mere surmise it must ever remain. But, on the other hand, while even the most advanced selectionists will doubtless allow that the earliest organic colour, or colours, were probably non-significant, they would be quite justified in opposing the hypothesis of assimilation, as above defined, on the ground that there is no reason whatever to suppose that the direct action of any environment upon an organism must necessarily produce in it a colouration identical with that of its environment; and Mr. Distant's own examples might be cited in support of this contention, *e. g.*, that a diet of hemp-seed turns Bullfinches black; that red and yellow feathers are produced in certain Green Parrots by feeding them on fish; that the feathers of *Cotinga* can be transformed from purple to brilliant red by the application of heat, and so forth—in all of which instances there is no colour similarity between the various causes and their effects ;* and still further experimental evidence might be adduced. Indeed, when we consider the numerous instances of non-significant colours known to us both in the organic and inorganic worlds, there can be no reasonable objection to the hypothesis that the earliest organisms might have developed, through purely physico-chemical causes, non-significant colours, both brilliant and otherwise, which might, or might not, have corresponded with those of their respective environments; and thus, when natural selection *did* become a *vera causa*, there would already have been a considerable range of colour upon which it might operate. However, with regard to the first appearance of this factor, it seems more reasonable to suppose that this was practically synchronous with the first appearance of organic life, though the struggle for existence at that period would be solely against the physical forces of nature, and thus natural selection would then have little or no effect upon colouration, except perhaps indirectly.

Supposing, however, that, for the sake of argument, we agree to accept Mr. Distant's general suggestion, we have yet to consider the correctness of his corollary thereto, which is really the essential portion of his paper. According to this view: "If the earliest forms of life are to be sought only in

* These examples were prefaced in the article criticized by the remark: "The view of a direct action caused by a constant food on animal colouration has frequently been remarked."—Ed.

an ancient geological record, it is also in that phase of animal existence that the beginnings of colouration must have developed. It therefore seems possible that assimilative colouration may have been a first and a very general consequent in animal development; and that the subsequent protective resemblance acquired by numerous living creatures through the process of natural selection, when life had advanced to the competitive stage, is far too frequently used as an explanation for whole series of uniform phenomena in colouration, which have probably survived unaltered from remote antiquity." (Pp. 383, 384.) And again: "As adaptation implies a previous state of variation, which again predicates a more or less stable condition from which variation arose, we come to the conclusion that the pre-variable condition was a unicolorous one, and from the data—scanty indeed—at our disposal, are inclined to suggest that the unicolorous hue was originally due to assimilative colouration." (P. 471.) In other words, it is suggested that the present unicolorous hues of such organisms as green birds and caterpillars, isabelline desert animals and flat fishes, &c., are preferably to be explained on the ground that they are survivals of an assimilative colouring which was acquired in early geological times, its persistence being due not to the direct action of natural selection, but to the fact that this colouring happened, quite by chance, to be of vital importance to the animals.*

Now, apart from other objections, the acceptance of such an hypothesis appears to me to land us at once upon the horns of a dilemma. Either we have to believe that these unicolorous animals have existed as we now see them since the "early stages of animal life," or we have to assume that these organisms, with their numerous ancestry, right back to the low generalised form from which they sprung in "remote antiquity," must have existed through countless ages of time and innumerable geological and climatic changes in an unchanging environment to which their primæval assimilative colouring chanced to be so well adapted, that natural selection has been quite unable to affect them in that respect throughout the entire period; although, be it noted, their structure has undoubtedly undergone, in most cases, very considerable modification.

This conclusion is to me almost as untenable as the previous one; and, as it is difficult to perceive in what other way the present phenomena of colour can be explained upon the suggestion of the survival of ancestral assimilative colouring, it seems to me that this hypothesis must fall to the ground. The fundamental error of the suggestion appears to lie in the fact that the development of colour has been regarded in a purely abstract light, and not in connection with the development of any particular animal or group of animals, as must be done in order to arrive at any reliable results.

* The inference, "quite by chance to be of vital importance to the animals," is not to be found in the pages criticized.—Ed.

It must be particularly pointed out that in Mr. Distant's general discussion of the subject he has most clearly suggested that the present day colouring, which is classed by him as assimilative (in opposition to adaptive) was *only* developed in the earliest geological epochs, and *prior* to the first appearance of natural selection as an efficient factor—according to his conception of that first appearance. Fortunately we are able to obtain, from certain passages, some idea as to this conception, for with regard to the Lias formation of the Jurassic Period (Mesozoic), when the gigantic Enaliosaurians abounded, it is freely admitted that "Here we see natural selection, with its iron and implacable rule, a real factor";* and, further, in the later essays on "Mimicry," good cause is shown for the recognition of the occurrence of natural selection so far back as the Carboniferous Period in Palæozoic times.

But when we come to consider the examples adduced in support of the above suggestion, we at once find that the fundamental proposition is practically disregarded. A single instance will suffice. Referring to the colouring of primitive man, it is remarked that: "Their colour would have been uniform, either derived from their more brutish ancestors, or, possibly, *a more assimilative colouration may have ensued* to the soil on which they walked."† It will be thus seen that the vast majority of

* This quotation with its context is as follows:—"Thus, after a period of animal evolution which may be computed by millions of years, and in which fish abounded, perhaps not yet altogether under a severe stress of selection and survival, the Mesozoic period arrives, when, in the words of Oscar Schmidt, 'the Placoids and Ganoids, hitherto predominating in the ocean almost without a foe, now found overwhelming enemies in the true Sea-lizards or Enaliosaurians, especially the Ichthyosaura and Plesiosauria.' Here we see natural selection, with its iron and implacable rule, a real factor in the lives and development of these creatures, connected and increasing with an advancing animal evolution, but still only a term to express the modifying influences incidental to a struggle for existence" (pp. 388–9).—Ed.

† Quotations are best unabridged. The following is as printed:—"As De Quatrefages has remarked, 'The first men who peopled the centre of human appearance must at first have differed from each other only in individual features.' Their colour would have been uniform, either derived from their more brutish ancestors, or possibly, as their habits became less arboreal, a more assimilative colouration may have ensued to the soil on which they walked" (p. 403).—Ed.

A previous paragraph, *not quoted*, reads: "But although facts may be found to support new suggestions, such as a possible original assimilative colouration of man, the quest for such produces other recorded observations, which, though not altogether contradictory to the view, still point to other causes, support other conclusions, and reassert the problem we seek to solve" (p. 400).—Ed.

instances cited by Mr. Distant are quite inappropriate as illustrations of his fundamental suggestions, though possibly they might be brought forward in support of a theory that assimilative colouration has been sporadically developed from recent geological times down to the present day.

On glancing through the quotations given, one is at once struck by the practically complete absence of anything in the way of experimental evidence as to the direct action of the environment, and this is the more strange seeing that such evidence is actually available. It will be sufficient to refer to the splendid series of exhaustive experiments made by Prof. Poulton upon the influence of both food and surrounding colours on the larvæ and pupæ of various Lepidoptera. These experiments have been carried out with the most scrupulous care and exactitude, and the conclusions which can be drawn from them are worth scores of hasty observations and occasionally inaccurate generalizations made by travellers and sportsmen. It would be beside the point to enter into details as to the results obtained by Prof. Poulton, since we are only discussing the possibility of the survival of primæval assimilation; but it may be mentioned that these experiments definitely prove that certain of these organisms possess, in varying degrees, the capacity of being modified in colour by the direct action of different light-waves; and, further, I consider it is sufficiently demonstrated that this capacity can only be satisfactorily explained by the theory of natural selection, and not by any theory of purely internal or external causes.

But to resume: with reference to the attempt to explain the crimson colour in the wings of the African Touracos (*Turacus* and *Gallirex*) as being due to the occurrence of copper in the districts which they frequent, I quite agree with the objections raised by Dr. Bowdler Sharpe.* In my experience of these beautiful birds, both in Natal and Mashonaland, I can find no connection between their distribution and the occurrence of coppers; and besides, the fact, noted by Mr. Distant, that they have been known to moult several times in captivity in England without impairing the brilliancy of their feathers, appears to entirely negative any such direct connection. Moreover, no attempt is made to explain why it is only these birds which are affected in this curious way; or why, in them, the effects are confined to a limited number of feathers.

It is noticeable that wherever phenomeua are explained upon the theory of natural selection a detailed explanation of the "why and wherefore" is always expected, whereas exponents of theories of purely environmental causes are so frequently content to confine themselves to the widest of generalities.

* Dr. Sharpe's objections are given on the page criticized, and given as a qualitative contradiction.—Ed.

Among the instances quoted by Mr. Distant as bearing on the suggestion that "Even the obscure problem of the colouration of mankind may have originally—and before migration became such an important factor in modification—been due to a more or less assimilative colouration," are some remarks (p. 398) on the natives of Mashonaland from a paper by the late Mr. W. Eckersley, whose acquaintance I made when he visited this country seven years ago. In one portion of his paper Mr. Eckersley states that "large areas of red soil are frequently met with"; in quite another part he mentions that the colour of the Mashonas is "dark chocolate-brown, some shades removed from black." As a matter of fact, the absolute proportion of red soil in Mashonaland is comparatively small, and, moreover, the vast majority of the Kafirs live on the huge outcrops of granite which constitute the great bulk of the plateau. But, quite apart from this, any argument for the hypothesis of assimilative colouration, based on the relation of the Mashonas, or indeed any of the Bantu tribes, to the soil they now inhabit, is entirely vitiated by the fact that we know that these tribes have come down from the North comparatively recently, and some of their migrations, at least, have taken place within historic times.* I certainly cannot agree with Mr. Distant's somewhat sweeping assertion that "the colour of mankind can in no sense come under the explanations of protective or aggressive resemblance . . . . . or nuptial colouration." Any one who has seen a Kafir in his native bush must have been struck by his inconspicuousness as compared with a white man, and there can be little doubt that this assimilation to his surroundings must be of considerable value for aggressive purposes (as, for instance, in stalking game which might frequently be of vital importance); further, Darwin himself has argued ('Descent of Man,' ed. 2, p. 604) that racial colouring may be to some extent due to sexual selection.

Unfortunately, suggestions of the type referred to above are only too easily made, and might readily be multiplied with a little ingenuity. For instance, we might suggest that, as swallows are eminently aërial birds, the great predominance of blue in their colouring is due to continual exposure to the blue sky, and we might seek for confirmation of this in the fact that the blue colour is principally found on the upper surface, which is most exposed to this influence; and, finally, we should pass over in silence the little difficulty as to the colouring of the Swifts.

* Mr. Marshall does not seem to have read a passage which might have mollified his strictures:—"It is true that assimilative colouration seems to have little modified the colour of indigenous races, even in Africa, if we take a comprehensive view of the whole area. But we must not forget that men have so often migrated from their original birthplaces, and, more than that, much mixture has taken place" (p. 399).—Ed.

Finally, I must mention the notes on the colouration of the Cat tribe. After referring to Darwin's remarks on the stripes occurring on young Lions, and also to Steedman's observation that these markings are likewise fœtal (p. 462), Mr. Distant proceeds to say: "It seems more in consonance with present knowledge and opinion to consider that spots, though primitive, were not original, and succeeded, not preceded, unicolorous ornamentation, which has survived only where it has been more or less in unison with the creature's environment, and so afforded aggressive protection, as in the case of the Lion" (p. 464). Seeing that the fœtal markings distinctly prove that, at least, the immediate ancestors of the Lion were striped animals, and that therefore its present unicolorous coat must have been subsequently acquired, it is certainly difficult to understand how this animal can be adduced as a survival of a supposed primitive assimilative colouration! *

In conclusion, I can only regret that my notes on Mr. Distant's paper have been perforce entirely critical. Although I, as a selectionist, cannot regard as sound the suggestions which he puts forward, I can still appreciate their value in drawing attention to these interesting topics. And I trust that some reader of the 'Zoologist,' more competent to discuss these matters than myself, will in turn point out any errors that may exist in my own arguments and contentions; for it is only by healthy discussion, followed by more careful observation and experiment, that we can hope to attain a true insight into those large biological problems, the solution of which is the ultimate aim of all natural science. — Guy A. K. Marshall (Salisbury, Mashonaland).

* On page 462, the writer of these suggestions, which Mr. Marshall is criticizing, actually states: "A fact, however, which very strongly stands against the view of original assimilative colouration here assumed, is found in the markings of the young of all the unicolorous Cats—Lion, Puma, &c.—which are more or less indistinctly spotted or striped; and as many allied species, both young and old, are similarly marked, Darwin has observed that 'no believer in evolution will doubt that the progenitor of the Lion and Puma was a striped animal, and that the young have retained vestiges of the stripes, like the kittens of black Cats, which are not in the least striped when grown up.' . . . . Taking the cases of the Lion, Puma, and Cheetah, we see that the two first, unicolorous in their adult stage, apparently show by their spotted young a derivation from a similarly coloured ancestor, whilst the spotted Cheetah, from the apparent evidence of its unicolorous young, would point to a totally different conclusion" (p. 463).—Ed.

NOTICES OF NEW BOOKS.

The Birds of Surrey. By John A. Bucknill, M.A. R. H. Porter.

Surrey, to the regret of many of its residents and of all its naturalists, is, to use the words of Mr. Bucknill, rapidly "degenerating into a colossal suburb." To those who were born in the county, and have passed their lives there, the truth of this saying is painfully apparent, and the success of the "City man" now too often means the disfigurement of the Surrey hills. The hand of the builder has fallen very heavily on this lovely county, residential estates are being opened out, and many of the rarer birds vanishing from its boundaries. The *ferœ naturæ* are receiving notices to quit. The preservation of game in this county seems too often designed to afford a London holiday, and the keeper decides what members of our fauna shall be exterminated in the supposed interests of his employers.

We are very thankful for this book, which gives the census of to-day; what it will be reduced to in another fifty years no man knoweth! Even now many of the rarer birds are confined to restricted haunts which may not be mentioned, and the writer of this notice only last May watched the Stone-Curlew within an hour's walk of the busy town of Croydon. The Magpie is sadly becoming less known every year, and villagers in many parts will tell you how they could always procure a nest, if wanted, with little trouble some years back. Now a solitary appearance is, in many parts of Surrey, quite an event. The Jay still survives the persecution of the keeper, and is probably in many woods much more abundant than is generally supposed. The Sparrow-Hawk is considered by Mr. Bucknill as "undoubtedly decreasing," though this year its visits to a poultry-yard at Warlingham on more than one occasion has proved that it does not restrict itself solely to the game-preserves around.

The writer has compiled with care, and, we are gratified to

see, largely from these pages. Much, however, is still to be learned about the birds of Surrey. Many considerable areas and little visited spots have not been sufficiently patrolled by the intelligent or judicious collector, whose operations for good or evil? have now been considerably curtailed by the legislature, and whose reputed powers of mischief on our avifauna, even in the cause of science, cannot be compared with the ignorant and ruthless destruction by the keeper, or the diabolical injury done by village bird-nesting urchins. But in an era of amiable fads and crotchets the British zoologist must lay low, and do good by stealth. In the coming years our records will be more of species supposed to have been seen than of those actually handled and correctly identified. The recent apotheosis of the Sparrow is an illustration of what may occur.

'The Birds of Surrey' should find a place in most county homes, but we were a little surprised to find no reference in the bibliography to the late Alfred Smee's 'My Garden,' which refers to the parish of Beddington and the river Wandle, and contains an interesting list of birds found in that section of the county.

The Birds of Cheshire. By T. A. Coward and Charles Oldham. Manchester: Sherratt & Hughes.

Another county has now had its ornithological fauna described, and it is singular that Cheshire has had to wait so long, though we read that "ornithology has found but few votaries among Cheshire naturalists"; and again, that, "compared with many other English counties, Cheshire has a remarkably poor avifauna." One hundred and ten species breed or bred until recent years within the county boundaries, but it is among the casual visitors rather than the residents that the deficiency is apparent.

The authors have, however, produced a volume which will not only be of value to all lovers of birds in Cheshire, but will afford interesting reading to that ever-increasing body, the intelligent students of British natural history. In fact, such books as these, which freely enter country houses, must do much to foster a love of nature in circles where more scientific zoology is *taboo*. Among

vertebrates, birds hold the same position as the Lepidoptera in the invertebrates; they are ever popular, and evidently appeal to the æsthetic sense. In any smoking-room men can be found who can say something about birds, while other animals, save such as appertain to sport, are too often distinctly *caviare*. We may therefore be thankful to ornithologists for always keeping their lamps trimmed, and sustaining a general interest in zoology.

One seldom reads a county book on birds without meeting with new or little-known facts, and this publication is no exception. Thus we are told that our old friend *Corvus frugilegus* often exhibits a preference for a particular tree in a rookery. "At Wythenshawe, Mr. J. J. Cash has counted forty nests in a single sycamore, which comes into leaf earlier than the surrounding elms and beeches."

The volume is embellished with six photogravure illustrations, and a map of the county.

Nature in Downland. By W. H. Hudson. Longmans, Green & Co.

This book may be described as a charming reverie on the Sussex downs by a naturalist. These bracing and rolling highlands are *appreciated* by two classes of visitors—the artist and the naturalist. The first absorbs the wild and somewhat monotonous scenery, and returns with a landscape engraven on his heart; the second patiently endeavours to read Nature's hieroglyphics, and to many, probably, appears as a lone and strange creature, like the local shepherd. Jefferies was the apostle of this method, and has evidently founded a school of thought which writes in prose what some of the older poets felt and sang in verse. But we shall never receive in print the deepest thoughts that Nature sometimes imparts; these things are fugitive, and never written. It is only a legend that the finest impressions of humanity may be found in books; the individual who might wish to print what should be unutterable is certainly outside the musings of the Sphinx. After all, the naturalist can only record facts; of his impressions he knoweth not whither they come or go. We would all gladly recall, if we could, some of these mysterious whisperings, but the quest is too often futile.

Mr. Hudson has wandered over these downs with his acquired natural history knowledge, an open mind, and his field-glass. He has described much of what he saw, and a good deal of what he thought ,and he has regarded Nature through his own spectacles, and introduced remarkably little of other people's theories. Consequently he has produced a most readable book, the style of which is in unison with the quiet and lorn country which he writes about.

We read that the Long-eared Owl frequented, "and probably bred, in the thorn, holly, and furze-patches among the South Downs until recently"; and he refers to what in humanity has been called "pre-natal suggestion," as exhibited in a lamb with an Owl-like face, which lived for a few days only. He also gives some quite startling facts as to the quantity of Wheatears formerly destroyed by the shepherds at the instigation and remuneration of the poulterers, and truly observes:—"It is not fair that it should be killed merely to enable London stock-brokers, sporting men, and other gorgeous persons who visit the coast, accompanied by ladies with yellow hair, to feed every day on 'Ortolans' at the big Brighton hotels." Ultra advocates of the theory of mimicry will find some remarks worthy of consideration respecting the Common Snail (*Helix nemoralis*). The shell of this species is on the downs mostly of one type, the ground colour being yellow, or yellowish white, with broad black longitudinal bands, and "often startles a person by its curiously close resemblance to a small portion of a highly-coloured Adder's coil. This chance resemblance to a dangerous creature does not, however, serve the Snail as a protection from his principal enemies—the Thrushes. Wherever there is a patch of furze, there you will find the 'Thrushes' anvil,' usually a flint half, or nearly quite, buried in the soil a few feet away from the bushes, and all round the anvil the turf is strewn with shattered shells."

Recollections of my Life. By Surgeon-General Sir Joseph Fayrer, Bart. William Blackwood & Sons.

This book is the narrative of a useful and successful life, passed for the greater, and certainly for the probationary period, in that administrative forcing-house where so many reputations

have been made—British India. The author has distinct claims to be ranked among zoologists; his 'Thanatophidia of India' is the result of long, original, and valuable work on the intricate subject of Snake-poisoning; he was the proposer at the Council of the Asiatic Society for an ethnological investigation of the Indian races, which produced Dalton's reports on the different tribes in Bengal; and he projected the idea of the Zoological Gardens at Calcutta, which he subsequently had the satisfaction of seeing fully accomplished.

In the volume as a whole, the reader will not find very much distinctly zoological information, but he will meet with a most entertaining history of his own time, which after all is the period whose story we can appreciate best, for it appertains to the incidents belonging to our own sojourn on the planet, and of these we know most. There is a romance in the past, but a reality in our own lives, and Sir Joseph Fayrer takes us again over the old ground. The Indian Mutiny and the Prince of Wales's visit to India are the connecting links of interest, though perhaps both subjects have already reached the stage of exhaustive record.

The myth of the great Sea-serpent is again before us. The author had corresponded with Lieutenant Forsyth, of H.M.S. 'Osborne,' relative to "a marine creature seen by the officers of that ship not far from Sicily." Sir Joseph is of opinion that "it can hardly be doubted that the numerous reports that we have had from time to time, though many of them perhaps are not very well authenticated, are sufficient to show that some undescribed gigantic ophidian or sea creature still remains to be identified."

We are sorry to see at p. 59 a reference to the Toucan in India. The Hornbill there is generally so called, but the mistake should never be printed.

EDITORIAL GLEANINGS.

In the 'Journal of the South-Eastern Agricultural College,' Wye, Kent, No. 9, issued in April last, Mr. F. V. Theobald has contributed an instructive article on "Diseases caused by Horse Worms and their Treatment." The following appear to be the major pests to the Horse:—

Amongst insects the Horse has several foes, including four species of Bot Flies. One of these flies, so far unidentified, forms warbles or tumours under the skin, like the Ox Warble. Probably this is *Hypoderma silenus*, but it is by no means common in this country; Mr. Theobald only remembers having seen one Horse attacked by it. The other Warble Flies live as parasites in their larval state inside the stomach and intestines (*Gastrophilus equi*, *G. hæmorrhoidalis*, and *G. nasalis*), where the bots cause annoyance and loss of condition, but seldom death. Lice of three species also annoy Horses turned out to grass, namely, the piercing-mouthed *Hæmatopinus macrocephalus*, or the Large Horse Louse, and two smaller species related to the Bird Lice, known as *Trichodectes pilosus* and *T. pubescens*, the former being the one most frequently seen, and is one of the three causes of that disfiguring rubbing of the tail. Numerous Diptera, such as the Gad Fly (*Tabanus bovinus* and *T. autumnalis*), Brimps (*Hæmatopoda pluvialis*), and others, suck their blood; whilst the Forest Fly (*Hippobosca equina*) causes annoyance in a few localities by tearing the hair and irritating the skin generally.

The three forms of "scab" or "mange" are also found on the Horse, caused by *Sarcoptes scabiei* v. *equi*, *Psoroptes communis* v. *equi*, and *Symbiotes communis* v. *equi*, mainly on weakly and ill-kept stock.

Amongst the vermiceous pests of the Horse we find representatives of the three great groups: *Cestoda*, or Tapeworms; *Trematoda*, or Flukes; and *Nematoda*, or Round Worms; but in this country the two former are rare and comparatively unimportant, for the loss they account for is slight. On the other hand, the *Nematoda*, or Round Worms, often are the cause of serious mortality, especially in young animals.

The Tapeworms found in the Horse are *Tænia perfoliata*, *T. mamillana*, and *T. plicata*. All three are uncommon, and do not seem to have occasioned any loss, nor do they seem to cause much inconvenience to their host. The two first-named species live in the intestines, but *T. plicata* is

also said to be found in the stomach. Although uncommon in this country, *Tæniæ* are often abundant in the Horses in Russia and Germany. *Tænia perfoliata*, the commonest species, infests the cæcum and small intestine, sometimes the colon. It is a small worm, seldom reaching more than two or three inches in length—Rudolphi records it as reaching 80 mm.; the head is provided with four suckers, and, like the other two species, is devoid of hooks; the proglottides are thick and short, and the colour creamy white.

Nematodes we find in all parts of the body. This group of worms, which contains so many parasites, is of much importance to those interested in Horses and Horse-breeding in all parts of the world, for they are often the cause of serious epizootic attacks, occasioning very considerable loss. These Round Worms are particularly plentiful in the intestines of the Horse, where perhaps they cause the gravest functional disturbances; but they also invade the kidneys, eyes, blood-vessels, serous membranes, skin, &c. In Europe our chief pests are intestinal in habit, often causing great mortality in foals. The following are those which are most prejudicial to the health of the host, and which may be considered general equine pests:—

(*Sclerostomum armatum*, *S. rubrum*, and *S. tetracanthum*.)

Two species of so-called "Red Worms" are well known in the Horse, but observations made tend to show that we have evidently three species to deal with, for the common Small Red Worm, usually taken to be the *S. tetracanthum* of Diesing, does not agree with the detailed description of that species, which Mr. Theobald has observed only twice in England. He has therefore proposed provisionally the name *rubrum* for this Small Red Worm, as a distinct species from the one described by Diesing.

(*Oxyuris curvula* and *O. mastigodes*.)

The Maw Worm (*Oxyuris*) is a very prevalent equine pest, but, as far as can be gathered, it only occasions slight functional disturbances in digestion, and violent burning and itching sensations in the rectum and around the anus. When present in large numbers the Maw Worms nevertheless cause emaciation, and cannot be otherwise than prejudicial to their host.

(*Ascaris megalocephala*.)

This is perhaps one of the best known worms in the Horse on account of its size, the female often reaching 14 in. in length, and the male from 6 to 10 in. It is a special parasite of Horses. In colour it is yellowish white and rigid; the oral region is restricted off from the body, and provided with three lips with teeth on their free margin. The ova are globular, and are produced by hundreds, and are passed out in the host's excreta; numbers also come away with the female worms that are frequently passed by the Horse.

(*Filaria papillosa* of Rudolphi; the *F. equina* of Abildgaard.)

Although seldom of fatal import, this Threadworm is often present in the peritoneal cavities of the Horse, Ass, and Mule. In one instance as many as would fill a basket (how large we are not told) were extracted from the thoracic cavity of a Horse by Menges, lungs and all being invaded.

Two species of *Spiroptera* are found in Horses, living in the stomach, namely, *Spiroptera megastoma* (Rud.) and *S. microstoma* (Sehn). They are both found in the right sac of the stomach. It is not probable that the second species is at all common, but the former is; neither, as far as can be learned, causes any serious functional disturbances; but the former, if in large numbers, might easily become dangerous.

We have received the Annual Report (1899) of the Millport Marine Biological Station. "The station is now in a position to supply sets of beautiful marine zoological specimens at moderate charges to private individuals, as well as to schools and other institutions. As science is now receiving so much attention in school training, it is hoped that such sets may ere long be possessed by every well-equipped school."

At the request of the Vice-Chairman, Dr. Gemmill, repeated and persistent efforts were made during last winter to fertilize the eggs of the Limpet (*Patella vulgata*, L.), and to rear the young up through all their stages, but without success. Fertilization of the ova was easy enough, and the keeping of the little brown, opaque, free-swimming larvæ up till the twelfth or fourteenth day, but at that age they invariably died off, excepting in the case of one culture, in which a few lived till the twenty-first day. From the sixth day onwards the water in the hatching-jars was found swarming with Infusorians, which soon devoured the unfortunate larvæ. Similarly, attempts were made, with varying success, on fertilized ova of crustaceans, molluscs, worms, and fishes, as well as on unknown ova obtained from the tow-nets. Failure, when it did occur, was doubtless largely due to the inability to imitate sufficiently the natural conditions of the sea, even by constant gentle movements in the hatching-vessels, and by continual circulation of pure sea-water. With the facilities at command many perfectly normal and healthy batches of *Echinus* larvæ were successfully hatched out, and the interesting changes in their development carefully watched from day to day. The young of the common Urchin (*Echinus esculentus*, L.) is a favourite with students of embryology, as its transparency makes it easy to follow the successive changes in structural development, even when alive and active. Some exceptionally good fertilizations of this echinoderm were obtained early in May by Dr. Thomas H. Bryce, Queen Margaret College, University of Glasgow, from which he has prepared

microscopic sections, the photographs of which, taken by Dr. J. H. Teacher, have been made into a very valuable series of lantern slides. A finely mounted set of these slides has been presented to the Station by the gentlemen named, and by means of the lantern given by Mr. Paul Rottenburg, of Glasgow, they can now be used for demonstration purposes.

Mr. W. Wells Bladen has taken a specimen of the Fresh-water Mussel (*Dreissensia polymorpha*) containing a very beautiful and perfect pearl. This shell was found in a large colony of the species in the North Staffordshire Canal, near Rugeley. The pearl attached to it is almost spherical in shape, and has a small protuberance at one side; it is 2 mm. in diameter, and is very pure in colour. This is said to be the first recorded instance of a pearl being found in this mollusc. The shell is figured in the Ann. Rep. and Trans. of the "North Staffordshire Field Club," 1899–1900, vol. xxxiv.

At Stevens' Auction Rooms two more eggs of the Great Auk were recently disposed of. One—an unrecorded egg—sold for three hundred and fifteen guineas, and the other egg for one hundred and eighty guineas. They were both bought by Mr. Gardner, of Oxford Street.

The 'Banffshire Journal' of June 5th last has published a letter received from Mr. J. A. Harvie-Brown, relating to Elvers, Eels, and Smolts. The following are extracts from same:—

"It is certain Elvers are largely consumed by Brown Trout for a few days. Soon after that, worm becomes the deadly bait. Why? Well, worm in low clear water, after the run of Elvers, becomes a necessary purge to Trout after the Eel 'stodge.' At least, I believe this to be the case—just as grass is an occasional vomit for a Dog.

"If Elvers are largely consumed by Brown Trout, they are also largely consumed by Sea-Trout, Grilse, and probably also by Smolts. What are known among Sea-Trout as Finnocks, at the mouths of our East Coast rivers in April, May, &c., are the Grilse of the Sea-Trout, which went down the previous year as Smolts, which went up as Grilse or Sea-Trout, do not breed, but attain a growth of up to, say, half a pound, or less, and come down again along with the Smolts of the Salmon. Their time so far is known to legislators, because fishing for Finnocks is prohibited whilst the Salmon Smolts are descending—*i. e.* about 15th May. The baskets of Sea-Trout and Finnock made in the spring months on the East Coast of Scotland—at Ythan, Deveron, Findhorn, &c.—are either down-run Kelts or unspawning Grilse of the Sea-Trout; or rapidly-grown Smolts of the

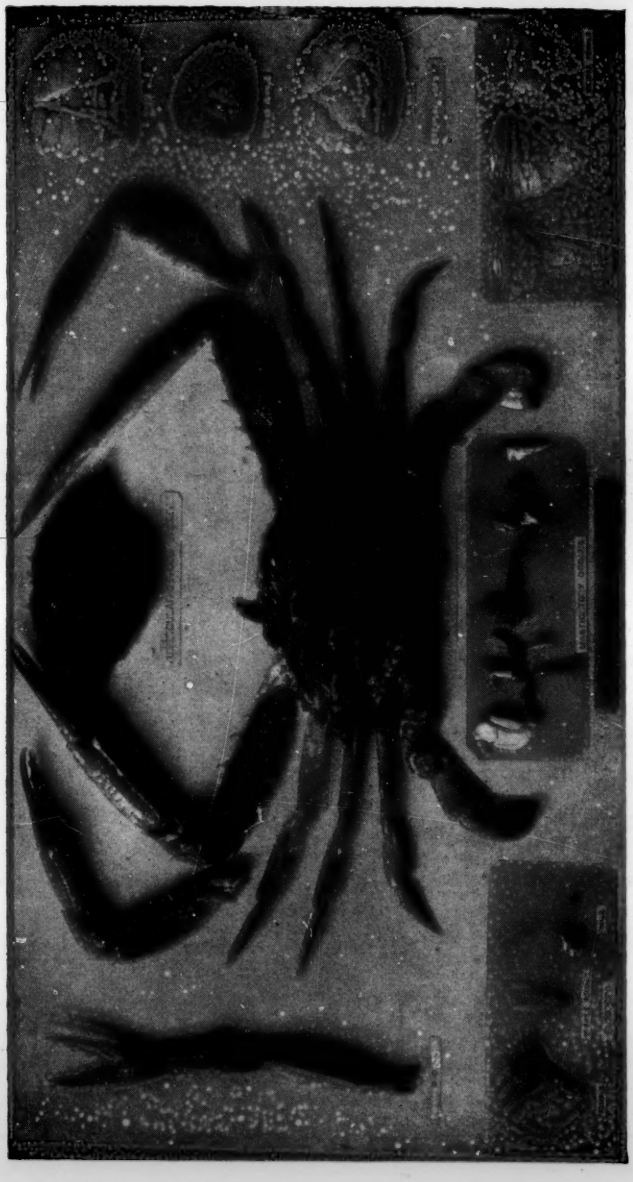
Sea-Trout; or Smolts of the Sea-Trout which have remained two years in the fresh-water streams, after putting on the silver. Thus we find Par ¼ lb. weight, but Smolts in silver often three inches long only, and others seven inches long. These, I take it, are the young of different hatchings, the larger of which are the progeny of older Salmon; the larger and smaller Par in the same way.

"Now, if Brown Trout feed—'stodge'—on Elvers, they lie in wait for them, because Brown Trout are not strictly migratory; but if Smolts and Sea-Trout Grilse also feed largely on Elvers—as I feel sure they do—they, being anodromous or migratory, come down in bulk to meet the Elvers. The first appearance of Elvers on any reach of water (on Deveron) wakes up the migratory instinct at once, and, acting almost like ground-bait, sets the Smolts and Sea-Trout Grilse—aye, and Salmon Kelts, too—on the move seaward. Thence the well-known name, 'A weel-mendit kelt.'"

We are glad to see from 'The Scottish Geographical Magazine' for June that it is proposed to organize and equip a Scottish National Antarctic Expedition, which will co-operate with the German and British expeditions now being fitted out, and devote its attention more especially to physical and biological oceanographical researches, and to geology and meteorology.

The Scottish vessel will be one of the ordinary Norwegian or Scottish type of whalers of about 500 tons, 130 ft. long, and steaming seven to eight knots. A ship of this size will have ample accommodation for thirty-seven all told. The proposed staff includes six scientists and five ships' officers, and a crew of twenty-six. The ship will proceed from Scotland on August 1st, 1901, to Port Stanley, in the Falkland Islands, which will form the base for operations in the Antarctic regions. She will proceed southward by Weddell's track in 30° W. This route has never yet been tried seriously with a steamer. Weddell, in 1823, penetrated far south with two sailing ships, one of 120 tons and one of 65 tons; Bellinghausen also was successful a little farther eastward. Ross, with sailing-ship, failed, but Larsen, with a steamer, reached 68° S. in about 60° W. The Dundee whalers, in 1892 and 1893, being on commerce bound, were chiefly occupied securing Seals, and, since these abounded in the vicinity of the Circle, they had no need to go farther south. There is little doubt that the ice can be penetrated by such a vessel as that above mentioned.

Mr. William S. Bruce will take command of the expedition with a whaling captain under him and four other officers; a naturalist will be permanently attached to the ship, and will take charge of and carry on the scientific work there during the leader's absence with the wintering party. The land party will land in a high latitude on the east coast of Graham's Land, and the ship will return northward for the winter.



NEPTUNUS PELAGICUS M.-Edw.